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ABSTRACT

Providing a general framework for local curriculum development, the guide is intended to assist industrial arts teachers and public school administrators in situations where a comprehensive curriculum development effort is undertaken, a new industrial arts curriculum is being developed, or an existing program is being revised. Four phases of coordinated planning and decision-making are presented: (1) establishing the basis for industrial arts in the K-12 school system; (2) establishing the basis for industrial arts on the various operational levels (elementary, junior high, and high school); (3) outlining the local industrial arts program; and (4) preparing teaching plans. Phase 1 involves establishing the need for the program and describing how the needs can be met and general program goals. Phase 2 is directed toward the needs of subpopulations within the school, with a recommended list of goals for each operational level. Phase 3 identifies the program offering, scope, and sequence. A suggested list of knowledge/skill/attitude competencies, developed by a team of Iowa industrial arts teachers, and corresponding sample learning activities are included for the offerings recommended. An eight-page reference/resource section is provided to assist with phase 4, which is directed mainly to the individual teacher. (EA)

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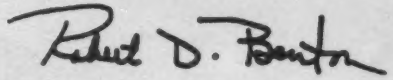
FOREWORD

Our concern for the curriculum of our schools prompts us all to continually seek ways to assess "what is" and identify ways to improve the educational activities and experiences now provided. Recognition of the need by many practitioners to strengthen the schools' efforts to develop the students' understanding of the technological, consumer, occupational, recreational and cultural aspects of industry prompted the development of this guide.

The early involvement and commitment of representatives of the Iowa Industrial Education Association and the State Committee on Industrial Arts Teacher Education in the development of this guide must be recognized as one of its major strengths. The continued involvement of those practitioners has contributed much to this effort to provide the type of information that is of assistance to those who are designing and implementing curricular experiences relating to industry.

The educational experiences proposed in this guide offer rich opportunities for students to become acquainted with their industrial technological culture. The format and content is uniquely helpful in providing information to managers of the learning process as they search for ways to assure that the career development goals and industrial-technological goals are incorporated in the educational program.

I am most pleased to be able to offer this assistance.



Robert D. Benton
State Superintendent of
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The Project Committee:
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CHAPTER I

PURPOSE AND USE OF THE GUIDE

Drawings & Design by Carlson & Partners

The Iowa Guide for Curriculum Improvement in Industrial Arts, K-12 has been prepared to assist teachers and public school administrators in improving the quality of their educational program.

The guide is a framework for local curricula development and thus avoids prescribing specific content and methodology. It gives the practicing industrial arts teachers and administrators the freedom and flexibility to innovate and develop unique approaches and methodology for a particular locale. The guide is intended for use in situations where a comprehensive curriculum development effort is undertaken, a new industrial arts curriculum is being developed, and an existing program or specific offering is being examined with consideration given to revision.

The guide should be of particular value to teachers interested in developing interdisciplinary units. Comprehensive programs and specialized courses can also be improved by applying the suggestions found in the guide.

For all of these situations it will be helpful to review the total curriculum process. Four phases of coordinated planning and decision making are essential. These phases are diagrammed and described in this chapter along with references to particular sections of the guide which will be of assistance in developing curriculum for K-12 industrial arts.

Local Curriculum Development Model

(Figure 1)

Phase I An appropriate basis is presented in the guide	Establish the Basis for Industrial Arts in the K-12 School System — Analyze student population to be served — Develop rationale for serving student needs — State general goals
Phase II An appropriate basis is presented in this guide	Establish the Basis for Industrial Arts on the Various Operational Levels — Analyze student sub-populations to be served — Develop rationale for serving needs of students in the various sub-populations — State operational level goals

Phase III

To be developed by local teachers or committee. This guide gives examples

Outline Local Industrial Arts Program

- Identify program offering on the various operational levels
- Prepare a scope and sequence model of the program offering
- Identify competencies to be developed in the specified offerings

Phase IV

To be developed by individual teachers. Suggestions are provided in the guide

Prepare Teaching Plans

- Organize content
- Develop measurable objectives
- Determine learning activities
- Select references and resources
- Design teaching strategies

Continuous Evaluation and Refinement

Phase I *Establishing the Basis for Industrial Arts in the K-12 School System*

The initial step in curriculum development is to establish a firm basis for the total program. Essentially it involves establishing the need for the program, describing how these needs can be met, and describing the general goals of the program.

A study of the cultural, technological, recreational, avocational, and occupational needs of students in the community quite likely will lead to identification of needs common to most American children. Industrial arts education has much to contribute to meeting the common needs of participants in our industrial technological society.

A philosophical statement or rationale should then be developed which describes the values of industrial arts and the ways it can contribute to meeting the needs of students in the community. It would probably include a definition, statement of purpose, and a description of the general goals of industrial arts.

The guide presents an appropriate rationale in Chapter II and general goals in Chapter III.

Phase II *Establishing the Basis for Industrial Arts on the Various Operational Levels (Elementary, Junior High*, High School)*

Here attention is directed toward the needs that are common to certain groups within the school. These groups are referred to as subpopulations, and may be defined on the basis of age, maturity, occupational goals, special abilities, and interests.

The curriculum organization follows the school operational levels of elementary, junior high, and senior high school in order to more effectively meet the needs of these subgroups.

For these subpopulations, industrial arts plays a different role regarding cultural, technological, recreational, avocational, social, and occupational functions. By identifying the needs of students in the various subgroups, one is able to develop a rationale that will serve as a basis for industrial arts activities which will meet those needs.

For example, on the elementary level it may be concluded that construction activities are needed to vitalize certain concepts in science or social science, or to acquaint students with types of work in certain career fields. The elementary teacher may incorporate construction activities in which these concepts must be applied and/or which give students experiences similar to those of workers in an industrial-technological career field. These are operational level goals that form the basis for further technological and career development.

As students mature, they need to explore and try their abilities in a variety of technological activities. They need to investigate interests and abilities, and test their self-concepts with respect to possible roles in the adult world. A well designed industrial arts program provides exposure to a vast number of technical concepts, techniques, and occupations. It is for this reason that comprehensive exploration goals are recommended for industrial arts on the junior high school level.

Some students in the senior high school are ready to prepare for an occupation; others wish to continue to explore certain industrial-technical concepts in more depth; and still others need outlets for constructive and avocational interests. Selecting program goals for this level demands consideration of both breadth and depth of study in special industrial-technological fields.

In Chapter IV, a recommended list of goals is provided for each operational level. Examples of expected outcomes are also presented to further define the goals and make them action oriented. The operational goals selected must be consistent with the general goals identified for the total program.

*The term "Junior High" is used in a generic sense in this guide and includes both middle school and junior high school grade levels.

Phase III *Outline Local Industrial Arts Program*

In this phase of curriculum development, the program offering on the various operational levels should be identified and a scope and sequence model developed. The recommended offerings, scope, and sequence are presented in Chapter IV.

Program offerings (units or courses) should be selected in terms of subpopulations to be served. For various reasons, such as, class size, facilities, and economics, it may not be possible to serve all students; however, every effort should be made to serve identified subpopulations in terms of the school's philosophy and resources.

Once the program offerings have been determined, attention should be directed toward identifying competencies to be developed in the various offerings. Competencies may be described as those knowledges, skills, and attitudes that the student should be able to exhibit upon completion of a specified course.

A careful analysis of the operational level goals and expected outcomes should provide insight into competencies which are appropriate for students in the various grades. In determining competencies for a particular course the local curriculum committee or teacher should (1) recognize that the competencies will be more specific than the expected outcomes listed in Chapter IV, and (2) strive to develop those competencies which are consistent with the operational level goals and maturity level of students. Assistance in this task may be obtained by consulting Chapter V. An investigative team of practicing industrial arts teachers in Iowa developed a suggested list of competencies for the offerings recommended in the guide.

Phase IV *Prepare Teaching Plans*

Whereas the previous phases of curriculum development may be a group effort, the preparation of teaching plans is usually the responsibility of the individual teacher. Included in this phase are such activities as selecting and organizing content, developing unit objectives and learning activities, selecting texts and references, and designing teaching strategies.

Content should be selected on the basis of the competencies to be developed. Too often in the past the reverse procedure has been practiced, often resulting in obsolete or irrelevant learning. In developing content, the local curriculum committee or teacher should analyze the competency with respect to the knowledge and skills students need to attain. These then become the content. For example, a competency of recognizing the basic elements of industry implies instruction under such content headings as research and development, production, marketing, and services.

The title of a particular unit should be in the form of a descriptive term or phase which indicates the major concept or subconcepts to be learned.

The units should be analyzed in terms of what the student should be able to do upon completion of the unit. Statements of these expected outcomes are called behavioral objectives. It is recommended that these be presented to the students prior to starting a particular unit. These objectives should be quite specific and with minimum standards of performance indicated. These objectives should be stated in measurable terms, and outcomes should be evaluated by observation, performance, or objective tests. The mastery of specified unit objectives should lead to attainment of competencies, and subsequently to realization of operational level goals.

The process of sequencing instruction involves analysis of prerequisite competencies needed to perform a particular competency, and determining a logical order for units of instruction.

The nature and extent of each unit or group of competencies should assist in determining the approximate amounts of time (emphasis) to devote to each of the courses to be developed or revised. Upon careful consideration, some units will probably suggest the establishment of courses of one-half school year, or less, in length. Others may necessitate a full year, or perhaps a two year sequence of courses.

Students master objectives and attain competence through successful participation in learning activities. The learning activities should be carefully selected to insure that they will enable the student to master expected outcomes. An analysis of the expected competencies and associated objectives will assist the curriculum developer or writer to create student learning activities which call for understanding and application of knowledge and skill, often in an attitudinal context. Some examples of learning activities for suggested competencies are presented in Chapter V.

The Reference and Resource section of the guide will provide assistance in selection of instructional materials for particular courses and units. This listing includes textbooks, references, curriculum guides for specific courses, and audio-visual aids. Since the list is not all-inclusive it is recommended that local curriculum planners and teachers continually review professional, commercial, and educational materials for new and additional resources. A careful analysis of resources in the local community will also help to enhance the relevance of industrial arts offerings.

The guide does not endorse any particular texts or curriculum materials. It is recommended, however, that teachers use those materials that will best enable them to attain the goals and provide the type of offerings recommended in the guide.

The development of appropriate teaching strategies for a specific level, course offering, and student population will vary from teacher to teacher. Each teacher has different experience levels, interests, and capabilities. The uniqueness of his personality necessitates a careful self-evaluation and selection of varied instructional approaches and teaching methods. The resources of the local community, and the availability of facilities and equipment also influences the teaching strategies selected. Chapter VI will provide insight into alternative methods and approaches of instruction which can be very effective in teaching the programs recommended in this guide.

Regardless of the process used for curriculum development no curriculum is ever perfect, nor complete, nor can it remain static. Weak points and inconsistencies will continuously arise in even the most carefully developed program. In view of our rapidly changing society, this is to be expected. The individual teachers, curriculum committees, and administrators should therefore strive to *continuously evaluate and refine the industrial arts curriculum.*

CHAPTER II

BASIC PREMISES

In the late afternoon of November 9, 1965, a small electrical relay in a power station in Ontario, Canada, failed. Within a few minutes the flow of electrical energy throughout much of the northeastern section of the United States and part of Canada had ceased. Some thirty million people, including those in the great metropolitan areas of New York and Boston, were plunged into darkness. The failure of electrical power left hundreds of thousands of New Yorkers stranded in subway trains, confined in stalled elevators between floors, or caught in monstrous traffic jams created by the absence of traffic lights. Even when they finally reached their homes, many of the city dwellers found them to be without warmth, without hot food, and without light. *Here was a dramatic demonstration of modern man's dependence on technology, for the fact is that we live in a "technological age." It has been called that, not because all men understand technology, but because we are becoming increasingly aware that technology has become a major disruptive as well as creative force in the 20th century.* The blackout of November 1965 gave ample proof of the role of technology in determining the conditions of our life and heightened our awareness of our dependence upon machines, tools, vehicles, and processes.

New Directions for Industrial Arts

Meeting the needs of society has always been a dominant factor in educational planning. The impact of technological evolution on our society has prompted much curriculum research and many program changes. The decade of the 1960's saw more curriculum innovations in industrial arts than any other period in its history. Most of these curriculum innovations sought to establish a more suitable content base for industrial arts and thereby derive more relevant content for a viable program in contemporary society.

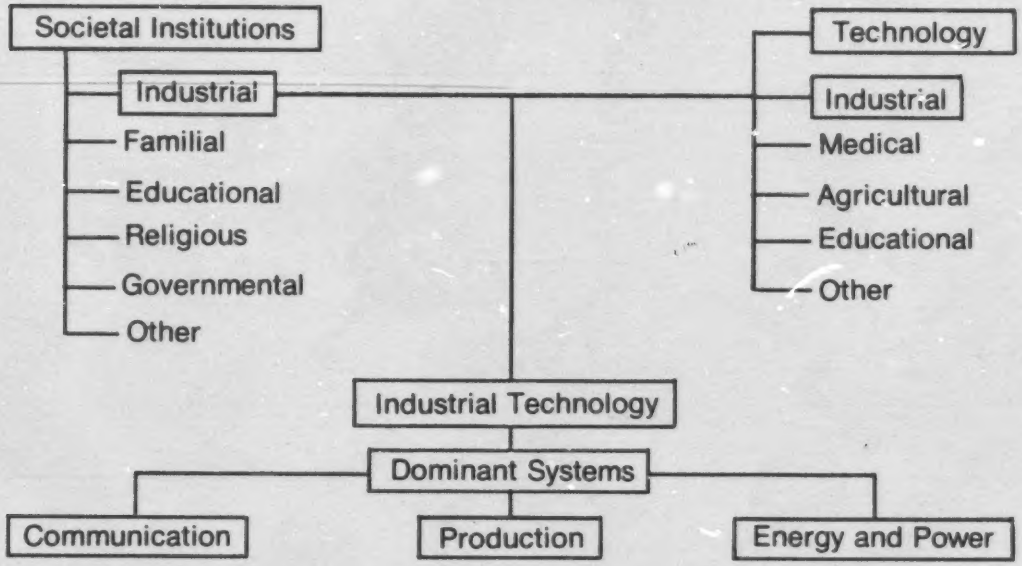
Industry has traditionally been considered to be the content base for industrial arts. Some contemporary leaders in the field are now advocating that a shift be made from industry to technology as a source of content. Their argument is that technology is becoming a separate discipline, whereas industry is not presently a discipline. According to Luekemeyer:

> *. . . yet even now technology is emerging as a distinct area of study and investigation.*
>
> *. . . while industry cannot, at the present time, be accurately referred to as an academic discipline studied in its own right, it might be referred to as at least a form of interdiscipline: that is, as a social institution studied by areas of various disciplines.*

Industrial Technology - The Content Base for Industrial Arts

It is a premise of this guide that technology, while it must be a part of the total school curriculum at all levels, cuts across all subject matter fields. Society has devised technological specialties such as medical technology, educational technology, agricultural technology, and industrial technology. It would, therefore, be inappropriate for industrial arts to assume the entire spectrum of technology as its content base. A fundamental premise of this guide is that industrial arts should draw its content from industrial technology. The basis for this premise is derived from the following model and its interpretation.

The Content Base for Industrial Arts
(Figure 2)



Our society consists of a number of institutions such as familial, governmental, religious, and industrial. Luekemeyer states that industry is a dominant societal institution:

> *. . . social scientists have described our society as one in which industry has emerged as the decisive, the representative, and the constitutive institution — a society, therefore, which industry stands out as the dominant social institution.*

Technology is the application of pure science. According to Dewhurst:

> *. . . technology consists of accumulated knowledges, techniques and skills, and their application in creating useful goods and services, the ultimate fruits of a country's technology are found in the standard of living its people are able to enjoy.*

Industry and technology by the above definitions are generic terms and are interdisciplinary. To structure the educational program for industrial arts it is necessary to identify the segments of industry and technology which are operationally appropriate for this subject matter field. The following premises describe the parameters of industrial technology as a content base for industrial arts.

Premise 1: *Industry* may be defined as a societal institution that develops and uses technology in conjunction with human and natural resources to develop, produce (substantially change the form of materials), and service industrial material goods. While industry consists of many subsystems, the major (dominant) systems of industry are communications, energy, and production.

Premise 2: *Industrial technology* is the systematized knowledge derived from the nature, the principles and practices, the products, the services, and energies employed by industry as it is defined above.

Premise 3: *Industrial arts* is that field which provides opportunities for all students from elementary through higher education to develop an understanding about the technical, consumer, occupational, recreational, organizational, managerial, social, historical, and cultural aspects of industry and technology. Futhermore, it is a field wherein students acquire industrial-technical knowledge and competencies through creative and problem-solving learning experiences involving such activities as experimenting, planning, designing, constructing, evaluating, and using tools, machines, materials, and processes.

Premise 4: The purpose of industrial arts is to provide a wide range of experiences that further the awareness and development of each student's career potential, technical abilities, judgment, self-reliance, and resourcefulness and knowledge of self to succeed as an effective producer and/or consumer in our technological society.

CHAPTER III

GOALS OF INDUSTRIAL ARTS

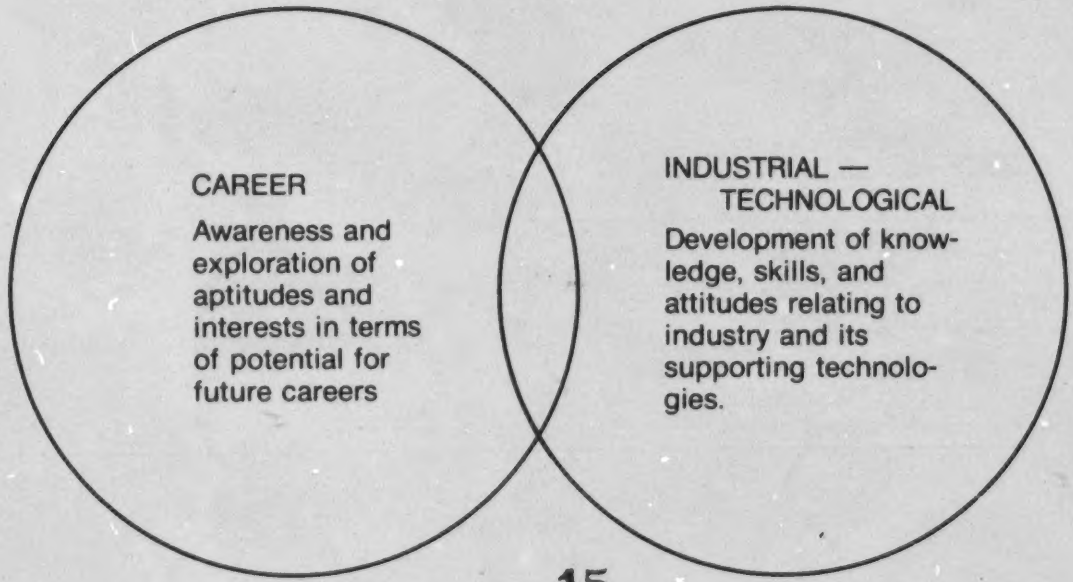
Well-formulated and attainable goals are essential to sound programs and provide the foundation for curriculum planning at all operational levels of the school. Two types of goals are presented here: general goals and operational level goals.

General Goals

The general goals are broad in nature and pertain to the entire K-12 industrial arts program. These goals are presented under two headings for the purpose of identifying and emphasizing new program directions. They are, however, inter-related and provide unique opportunities for the student to learn about industry and its supporting technologies, and to assess self-potential for possible future careers in the industrial sector of our economy.

Goals of
Industrial Arts

Figure 3


CAREER
Awareness and exploration of aptitudes and interests in terms of potential for future careers
INDUSTRIAL — TECHNOLOGICAL
Development of knowledge, skills, and attitudes relating to industry and its supporting technologies.

Career Emphasis Goals. Career education is the responsibility of the total school curriculum and includes all disciplines. It provides for an integrated and cumulative series of experiences designed to help each student achieve increased ability to make relevant decisions about his/her life, and increased ability in the performance of his/her life roles. Industrial arts shares this responsibility and can make unique contributions to career education by providing opportunities whereby each student will:

Develop an understanding and appreciation of the role of the worker in industry and society, and positive attitudes toward life and work.

Become aware of and explore talents, aptitudes, interests, and individual potential related to careers in industrial fields.

Develop an understanding of career opportunities in industry, and develop those traits that will help students obtain and maintain employment.

Industrial — Technological Emphasis Goals. Industry is a major economic segment of our society which applies material and human resources to develop, produce, distribute, and service something of value. Industrial technology is the accumulation of knowledge, skills, and attitudes, and their application in industry. Since industry and its technology is one of the predominant characteristics of our society, it is essential that in industrial arts opportunities are provided to enable each student to:

Develop an understanding and appreciation of the importance of industrialization within modern social and economic life.

Develop an understanding of the interdependence of society and industrial technology.

Develop proficiency in properly using tools, machines, techniques, and processes.

Develop problem-solving and creative thinking abilities.

Develop knowledge of industrial materials, processes, and products.

Develop knowledge and abilities relating to the basic elements of an industrial enterprise.

Promote the development of consumer knowledge and avocational interests.

These general goals provide a framework for subgoals at each of the three operational levels (elementary, junior, and senior high). The operational level goals are more specific; however, they are consistent with the general goals.

Operational Level Goals. The operational level goals describe the function of industrial arts at the various grade levels. They thus contribute to the particular aspects of the general goals that are emphasized, and provide insight into the expected levels of student attainment. They may be considered subgoals of the general goals. Courses developed for a particular operational level will contain *specific objectives, and these should be consistent with the operational level goals.*

ELEMENTARY LEVEL

Career Emphasis Goals	Examples of Expected Outcomes
	As a result of learning experiences at the elementary level the student will be able to:
A. To develop an awareness of occupations representative of the industrial/technical world.	Identify and differentiate careers that represent a wide variety of occupations.
B. To assess individual interests and abilities related to industrial/technological occupational clusters.	Describe and identify his/her interests, abilities, aptitudes and skills for a better understanding of self.
C. To develop insight into the personal and social significance of work.	Demonstrate a positive attitude toward work as evidenced in good work habits, including pre-planning and organizing an activity, respecting the rights of others, and completing a task once it is started.

Industrial-Technological Emphasis Goals	Examples of Expected Outcomes
	As a result of learning experiences at the elementary level, the student will be able to:
A. To foster insight into the importance of industry in our industrial-technological society.	Describe in general terms the role of industry in contemporary society.
	Provide examples of the interdependence of society and industry.
B. To develop awareness of the systematic process for providing services.	Describe in general terms a systematic plan for the accomplishment of the production of a marketable product.
	Describe in general terms the role of servicing industrial products in our technological society.
C. To foster awareness of the evolutionary development of industry and technology.	Describe in general terms how technological advancements have influenced industrial development.
	Provide several examples of how advancements in industrial technology have changed our standard of living and system of values.

D. To instill recognition of the basic elements of an industrial enterprise.	Identify and briefly describe the major system elements of an industrial enterprise (research and development, production, marketing and distribution, maintenance and services). Identify and describe the major resource elements of an industrial enterprise (finance, manpower, materials, power and energy, and property). Identify and describe the major coordinating elements of an industrial enterprise (management and communications).
E. To develop awareness of the influence of technology on society and the environment.	Discuss technological advances with their social and environmental import. Provide examples of his/her use of technology in the environment.
F. To promote insight into technological aspects of communication, production, and energy systems.	Identify and correlate sources of energy with their primary use by man. Select and state techniques for communication. Perform operations using special tools, jigs, fixtures, and machines.
G. To develop fundamental psycho-motor skills necessary to perform technological tasks.	Alter the shape of materials using a variety of processes. Correctly and safely use basic tools in the construction of projects or performance of operations related to the manipulation of materials.
H. To develop awareness of the interrelationships of technology and traditional subject matter.	Manipulate tools and materials in construction activities which reinforce, enrich, motivate, and increase learning related to basic elementary subjects and personal needs. Apply elements of the traditional subjects to the solution of technological problems and projects.

JUNIOR HIGH LEVEL

Career Emphasis Goals	Examples of Expected Outcomes
	As a result of learning experiences at the junior high level, the student will be able to:
A. To provide opportunity for exploratory experiences related to a wide variety of industrial technological occupations.	List a variety of common processes and techniques used in each of the basic industrial clusters.

	Solve simulated problems representative of selected career roles through the application of technology.
B. To foster further self-assessment through investigation of career opportunities and requisites.	Identify and compare, industrial-technical occupations.
	Describe in general fashion the requirements for entry into a specific career.
C. To promote the ability to make tentative, but meaningful career choices.	Identify several sources of occupational information.
	Make tentative choices or selections regarding educational and occupational goals.

Industrial-Technological Emphasis Goals	Examples of Expected Outcomes
	As a result of learning experiences at the junior high level, the student will be able to:
A. To improve proficiencies in selecting, caring for, and using goods and services of industry.	List criteria for determination of quality in products produced by industry.
	Demonstrate proficiency in caring for and using the goods and services of industry.
B. To develop an understanding of industrial technology and its place in our culture.	Relate societal and industrial changes to technology and its development.
	Provide examples of the interdependence of industry and society.
C. To further develop knowledge of the basic elements of an industrial enterprise.	Describe in general terms the duties of each job function in a typical industrial enterprise.
	Develop a line and staff organizational structure that might be used to staff a student-run industrial enterprise.
D. To enable students to become familiar with the application of technology to the solution of industrial problems.	Apply, demonstrate, and exhibit industrial processes and techniques through laboratory experiences such as mass production, enterprise organization, material forming processes, and the use of synthetic materials and finishes.
E. To further develop safe working habits in the use of industrial tools and machines, materials, and processes.	List the safety requirements of specific tools and machines.

	Relate the safe working practices in the laboratory to situations in the school, home, and community.
F. To improve problem-solving and creative abilities.	Apply, demonstrate, and exhibit scientific, mathematical, and technical principles through the solution of practical problems.
	Solve problems through planning and constructing activities occurring in group and individual research, experimentation and development.
G. To further develop basic proficiency in the use of tools, machines, techniques, and processes.	Demonstrate an effective and efficient use of primary tools and materials.
H. To increase competency in mastering technological concepts related to industrial materials, processes, and products.	Describe in general terms the processing concepts involved in the alteration of selected materials.

SENIOR HIGH LEVEL

Career Emphasis Goals	Examples of Expected Outcomes
	As a result of learning experiences at the senior high level, the student will be able to:
A. To provide for further assessment of abilities, aptitudes, and interests as they relate to various occupations.	Analyze industrial technical occupations in specific industries and career clusters.
	Develop a projection for his economic future in a specific career with consideration given to the changeability of our industrial technological society.
B. To enable the student to investigate opportunities and requisites of industrial-technological occupations in the area of his/her interests.	Utilize sources of assistance and information regarding occupational and educational pursuits.
	Compare and contrast the common job activities of several industries in a common industrial cluster.
C. To provide in-depth experiences in specific courses leading to career specialization and additional skill development.	Identify a preferred career option for future employment, or enrollment in a post-secondary career program, or baccalaureate degree program.
	Develop skills and knowledge in a particular industrial cluster which may lead to employment and/or future education.

Industrial-Technological Emphasis Goals	Examples of Expected Outcomes
	As a result of learning experiences at the senior high level, the student will be able to:
A. To enable the student to relate the elements of industry to the production of goods and provision of services.	Describe how the elements of industry relate to the production of goods in industry.
B. To promote the development of creative abilities in solving problems typical of specific contemporary industries.	Solve simulated industrial problems in a safe and efficient manner.
	Exhibit a degree of creativity in the design and production of industrial products.
C. To further develop the ability to evaluate the quality of industrial products.	Evaluate manufactured and constructed projects and products in terms of quality of construction, appropriateness of materials, functionality of design, and utility of purpose.
	Display proficiency in functioning as an intelligent consumer in the selection, purchase, use, and maintenance of the goods and services of industry.
D. To provide experiences directed toward the further development of knowledge of technological information and principles.	Compare and contrast the major processes used in a selected industrial cluster.
	Describe the application of significant advances in technology to processes and techniques currently used in a specific industry.
E. To increase proficiency in the use of tools and machines, materials, and processes in solving practical manufacturing, communications, construction, and energy problems.	Demonstrate proficiency in the use of tools, machines, and materials of a selected industry in a safe and efficient manner.
	Apply the processes of industry to the successful production of goods or services.
F. To provide in-depth experiences in the application of technology to the production of goods and services.	Apply technology to the solution of problems related to the production of goods or the rendering of a service.

CHAPTER IV

THE RECOMMENDED PROGRAM, SCOPE, AND SEQUENCE

Elementary school industrial arts provides students in the lower grades with INSIGHTS into, and an AWARENESS of our industrial-technical society. Instruction concerning the world of work includes the many kinds of work that people do, and the interrelationship of such work to the production and consumption of goods and services. The related study of the contemporary and historical role man has played in developing his natural resources serves to unify and focus basic subjects on man's development through the application of technology. Learning activities include the opportunity to explore, manipulate, experiment, plan, and create through the utilization of tools, materials, processes, energy, information, and machines.

Industrial arts courses on the *junior high* level must give consideration to the nature and goals of the early adolescent, which is a critical time in human development. During this time, the student seeks independence, is sensitive to peer acceptance, establishes a value system, expands intellectual capabilities and experiences, and experiences awareness of physical body changes. Courses in industrial arts at the junior high level should provide EXPLORATION of the adult world of work, the economics of industrial occupations, and aid significantly in the development of SELF CONCEPTS. Experiences and activities at this level should enable the student to develop an understanding of the role of contemporary industry in our culture. Special concerns of the industrial arts courses at this level are the common learnings needed by all persons to function effectively in our industrial-technological society; attitudes, interests, abilities and skills problem-solving, and understanding of the world of work.

At the *senior high* level, industrial arts provides a concentrated and specialized study of industrial technologies. At this level, students are concerned with career EXPLORATION IN DEPTH, and BEGINNING SPECIALIZATION in clusters areas that are of interest to them. Since students at this level display a wide range of interests, abilities, and life goals, the industrial arts program must provide separate courses or varieties of learning options within courses which may have vocational potential for some, avocational potential for others, and professional potential for still others.

The Career Cluster Concept

The career cluster concept holds that careers may be classified into logically related groups on the basis of identical or similar elements. This enables certain core educational experiences to be established which will facilitate learning or performance in all careers within the cluster.

Several advantages of the cluster concept include provision for students to (1) appraise interests and abilities in a wide variety of careers; (2) see relationships and commonalities in specialized skills, knowledges, and concepts; (3) exercise greater flexibility in occupational choice patterns; (4) obtain skills and knowledge necessary for job entry in several related careers; and, (5) have transferable skills and knowledge that promote adaption to technological change.

The cluster concept in industrial arts provides for study of interrelated careers and technologies in the industrial segment of our economy.

A working description of the systems recommended for industrial arts follows:

Communication Systems. An area of study involving techniques and processes used to transmit ideas, knowledge, or information from man to man, man to machine, machine to man, or machine to machine.

Production Systems. An area of study involving techniques and processes used to produce goods and render services. A study of Production Systems deals with the integration of personnel, materials, processes, energy, information, and machines to manufacture or construct a product of value to society.

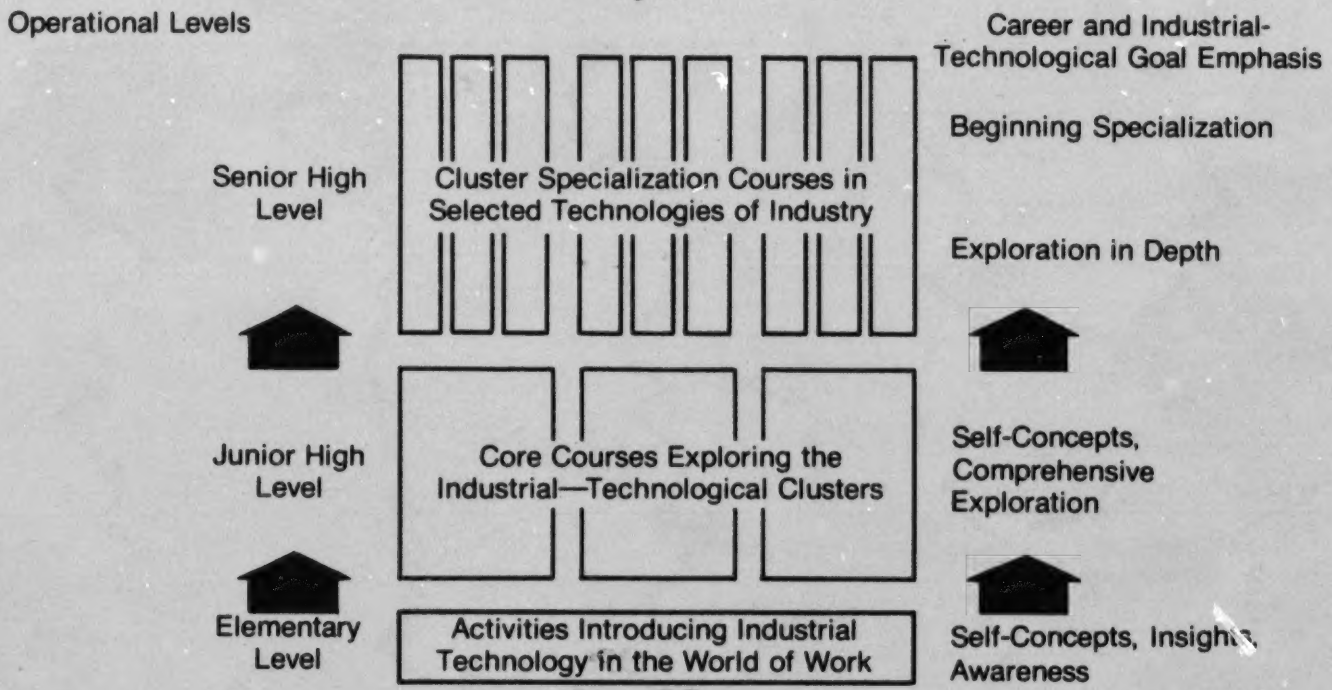
Energy Systems. An area of study involving the techniques and processes used to do work. Power is the application of energy to accomplish work.

The Pyramid Concept

The industrial arts pyramid concept is conceived as a means of developing career and industrial-technological awareness, self concepts, exploration, orientation, and some degree of specialization. It is aimed at helping all students to become *familiar* with the values of an industrial-technological society, to *integrate* these values into their personal value system, and to *implement* these values in a way that becomes meaningful and satisfying. The pyramid program concept allows pupils to explore fully the range of industrial technology, to develop skills which may lead to employment, and to study specific industrial technologies for avocational interests, or for preparation in post high school educational pursuits.

The Industrial Arts Pyramid Concept

Figure 4


Operational Levels
Career and Industrial-Technological Goal Emphasis
Beginning Specialization
Senior High Level
Cluster Specialization Courses in Selected Technologies of Industry
Exploration in Depth
Junior High Level
Core Courses Exploring the Industrial—Technological Clusters
Self-Concepts, Comprehensive Exploration
Elementary Level
Activities Introducing Industrial Technology in the World of Work
Self-Concepts, Insight, Awareness

Program Offerings

A description of the recommended program offerings is presented by operational levels.

Elementary Level. The offerings at the elementary level are drawn from the broad cluster areas of communication systems, production systems, and energy systems. Industrial arts should be an integral subject matter area or technology experiences closely correlated with other subject areas. The type of learning activities depends upon the philosophy of the school, the facility available, and the education of the teacher. For these reasons, it is not desirable to attempt to rigidly structure activities or to closely define scope and sequence. At all elementary grade levels the diverse needs and interests of pupils require individual attention. The young child should be engaged in learning activities which are active, constructive, enjoyable, of brief duration, and related to the general objectives of the elementary school, industrial arts, and career education.

Junior High Level. The program at the junior high level consists of a series of courses designed for student exploration of particular clusters. A working description of the recommended courses follows:

Graphic Communications: an area of study involving personnel, systems, and techniques in communicating ideas, knowledge, and information for the production and servicing of industrial goods. Graphic Communications encompasses all of the content of drafting, design, printing, photography, and graphic arts, as well as other graphic reproduction processes used by business and industry. Graphic Communications may be represented on many types of materials, singly or in unlimited numbers, immediately and/or on any occasion.

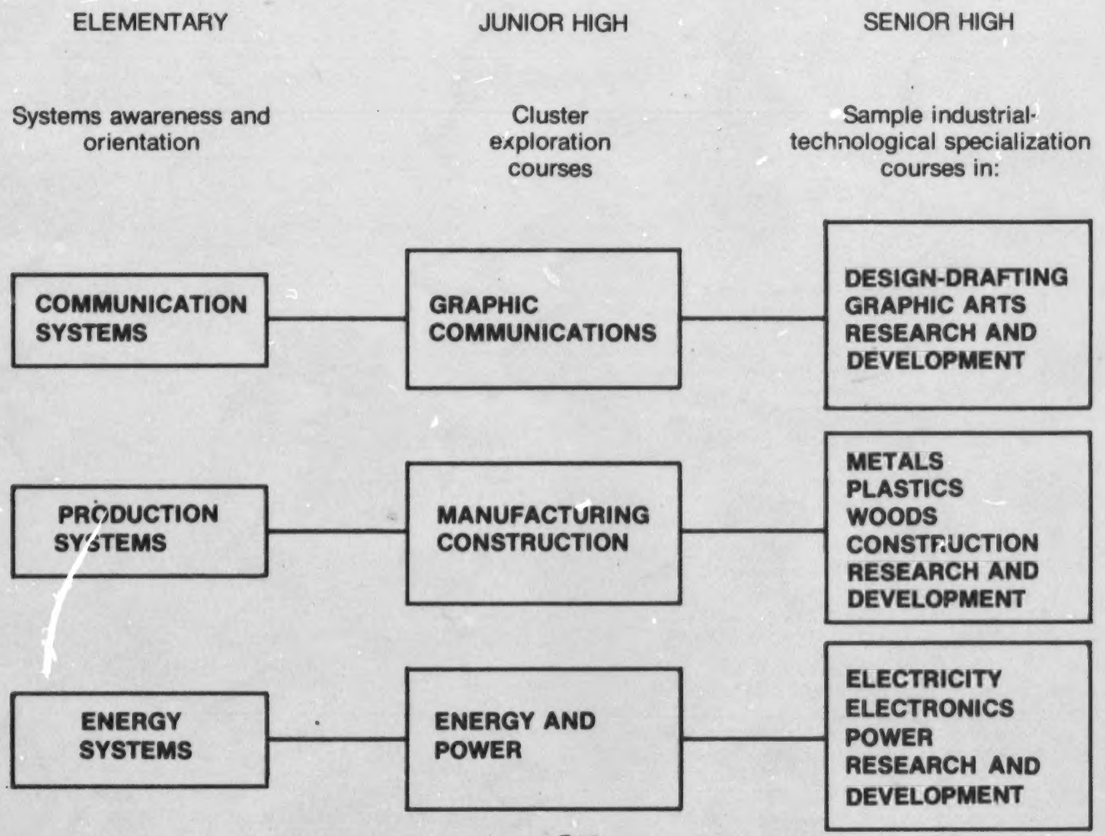
Manufacturing: an area of study involving management, personnel, and production techniques for creating finished goods in a plant or factory. Students research, design, engineer, and produce many products of varied materials using selected processes. Activities include role-playing situations, as well as lab experiences in planning, organizing and controlling available resources necessary for mass producing products.

Energy and Power: an area of study involving conversion of energy to different forms of useful power and the means by which this power is generated, transmitted, and controlled to serve man and industry. Instruction covers sources, generation, conversion, transmission, and utilization of power. Content would involve such areas as: solar, nuclear, hydro, combustion, electrical, hydraulic, pneumatic and mechanical forms of power.

Construction: an area of study involving practices which are required to build any structure such as a road, dam, utility network, building, tower, or tunnel. Concepts are applied in industrial laboratories to reinforce the students' understanding of how one plans, organizes, and controls all available resources to produce products on a site.

Senior High Level. Courses pertaining to particular industrial technologies are recommended. These courses should emphasize the technology of contemporary industrial materials, process, organization, and careers. A model of an articulated curriculum stemming from the three industrial-technological systems follows.

The Recommended Program Scope and Sequence Model
Figure 5



Recommended Scope and Sequence

It is recommended that the following program be provided at the various operational levels:

ELEMENTARY LEVEL (K-5 or K-6)

Content Emphasis: Awareness and orientation in industrial-technological systems: production communications, and energy.

Instructional Approach: An integral subject matter area, or technology experiences closely correlated with other subject areas.

JUNIOR HIGH LEVEL (5-8 or 7-9)

Content Emphasis: Exploratory experiences in three systems: production, communications, and energy.

Instructional Approach: Cluster exploration courses. The equivalent of *one year of instruction is recommended for all students. Courses available in at least two systems.*

Description of Exploration Courses:

Production Systems:

Manufacturing Cluster (the study of in-plant production systems)
Enriched program: 1 period* daily for 36 weeks
Minimum program: 1 period daily for 18 weeks

Construction Cluster (the study of on-site production systems)
Enriched program: 1 period daily for 36 weeks
Minimum program: 1 period daily for 18 weeks

Communication Systems:

Graphic Communications Cluster (Design-Drafting, Graphic Arts)
Enriched program: 1 period daily for 18 weeks
Minimum program: 1 period daily for 12 weeks

Energy Systems:

Energy and Power Cluster (applications of energy to serve man and industry)
Enriched program: 1 period daily for 18 weeks
Minimum program: 1 period daily for 12 weeks

*A period is considered to be the equivalent of 50-55 minutes in length. This is a suggested time frame and should not be interpreted as a school standard.

SENIOR HIGH LEVEL (9-12 or 10-12)

Content Emphasis: Exploration in depth and beginning specialization in production systems, communication systems, and energy systems clusters.

Instructional Approach: Cluster specialization courses. *Electives for all students.*

Program Recommendations: Courses should meet at least one period per day for each term (semester or trimester).

At least three courses should be available in each cluster.

There should be no prerequisites for the first course in a sequence on this level, unless a cluster exploration course is offered on the tenth grade level (which may be necessary in some smaller school systems).

Opportunities for further individual exploration, specialization, research and development should be available in each cluster.

Suggested Industrial-Technological Cluster Specialization Courses:

Production Systems

Such courses as:
- Metals
- Plastics
- Woods
- Construction
- Research and Development

→ Technology of industrial materials, processes and organization

Communication Systems

Such courses as: Design-Drafting → (Design process and drafting standards)

Graphic Arts → (Design and reproduction of graphic materials)

Research and Development

Energy Systems

Such courses as: Electricity/Electronics → (Electrical power generation, transmission and utilization)

Power → (Generation, transmission, and utilization of thermal, mechanical and fluid power)

Research and Development

CHAPTER V

SELECTED STUDENT COMPETENCIES AND SAMPLE LEARNING ACTIVITIES

In this chapter, guidelines are presented for developing specific offerings or courses at each of the three operational levels of industrial arts. The competencies describe the knowledge, skills, and attitudes that students should be able to exhibit upon completion of the recommended offering or course. In this sense, they become educational objectives for the course.

Learning activities provide the student with opportunities to practice the kind of behavior implied by the objective. No attempt was made here to provide an exhaustive list. The intention was to provide an initial idea bank of possible learning activities for students. Each teacher will need to develop student activities and plan experiences which best meet the needs of his/her students. There are certain general principles that apply to the selection of learning activities and experiences.

1. They should provide the student an opportunity to practice the kind of behavior implied by the competency or objective.
2. The student should acquire satisfaction from carrying out the activity.
3. The activities should be within the range of possibility for the students involved.
4. There are many types of activities that can be used to attain the same competencies or educational objectives.
5. The same learning activities will usually bring about several outcomes. That is, the student will acquire certain information, interests, skills, and attitudes that may not apply to certain objectives but may apply to several objectives or competencies.

The following selected student competencies and idea bank of sample learning activities were developed by the Investigative Team.

Elementary Level

At the Elementary Level, learning experiences in industrial arts will be directed primarily toward the child's development of an awareness of and insight into the historical contributions, present practices, and future potentials of industry and technology. Instruction at this level will also be directed toward the development of awareness of numerous industrial/technological careers.

KNOWLEDGE LEVEL-COGNITIVE DOMAIN

Selected Student Competencies	*Sample Learning Activities*
Experiences and activities at the Elementary Level will enable the student to:	
A. Identify industries and products produced in the locale of the school.	Use the yellow pages of the phone book to determine what products are produced. Read the newspaper ads to learn about locally manufactured products. Visit industries to observe production and organization.

B. Name or list ways in which parents and other acquaintances depend upon local industries.	List a number of examples of the importance of local industry in your daily living. Interview several of your neighbors and have them explain orally the importance of local industry to their life.
C. Name or list a number of examples of how one local industry depends upon another.	Describe several examples of how one local industry depends upon another to the class.
D. Describe the importance of individual contributions in an organized production system.	Participate in a small group discussion on the role of the individual in an organized production system. List ways in which individuals rely on the services of others.
E. Name common tools and machines used in the production of a simple product.	Identify the common tools and machines from a collection of pictures of tools and machines taken from a sales catalog.
F. Identify and describe basic system and resource elements of an industrial enterprise.	Compile lists of how the basic elements of industry are used in industries in the locale of the school.
G. Describe the line of authority and responsibility in an industrial table of organization.	Name various jobs found in a typical table of industrial organization. Discuss the line of authority and responsibility used in an industrial organization in a small group session; select a group leader and present the group findings to the class.
H. Describe the management functions carried out by people at various levels in an industrial table of organization.	Perform management functions at various levels.
I. List the common systems used by man to produce goods and services.	Select the common technological systems from a list of random systems.
J. Apply the principles of man's technology.	Demonstrate physically how raw materials are transformed into end products through participating in a mass production activity.
K. Express awareness of the evolution of man's technology.	In a small group, construct an example in model form of the type of housing used in a particular period of history. Present a report to the class on the rate of technological advancement in a specific country and the impact of this on the life style of its people. Bring in a series of newspaper clippings of examples of man's dependence on technology.

SKILL LEVEL-PSYCHOMOTOR DOMAIN

Selected Student Competencies	*Sample Learning Activities*
Experiences and activities at the Elementary Level will enable the student to:	
A. Plan for the production of a simple product.	Establish a simple organizational structure and company name for a class corporation.
	Study the sales catalogs at home and pick out several products which might be produced by the class.
	Participate in a class discussion concerned with listing the steps of production of a selected product in sequential order.
B. Perform in a safe manner the operations with tools and materials which are needed to manufacture a simple product.	Select a work responsibility in a class line production activity and successfully perform the worker responsibility assigned to your production task.
	Develop safe practices in the manipulation of tools and materials.
C. Develop a greater eye-hand coordination.	Construct a simple model of an early transportation device to be displayed in a group project on transportation.
	Design and construct a puzzle of a cartoon figure.
	Properly assemble wires in a simple buzzer circuit.

ATTITUDINAL LEVEL-AFFECTIVE DOMAIN

Selected Student Competencies	*Sample Learning Activities*
Experiences and activities at the Elementary Level will enable the student to:	
A. Show awareness of the importance of learning about industrial technology.	List examples of man's dependence on technology in his daily life.
	Participate in a class discussion of the local communities' dependence on technology.
B. Show sensitivity to human needs and social problems in a technological society.	Write a report on the enslavement of man by technology, and suggest ways by which man could be made less dependent on it.
	Report on or dramatize the ways technology has helped to free man from drudgery and to improve his life style.

C. Exhibit an appreciation for a job well done.

Construct a project, and conduct a self-evaluation of its design and workmanship.

Evaluate commercially produced products, and list the good and poor factors regarding its design and appearance.

D. Formulate the concept that people are dependent upon one another.

List the functions of class members involved in the production of a mass production product.

Write a paper on the role of various community work roles to the happiness of the entire community.

Arrange for a class visit to local service industries, and participate in a class discussion regarding the importance of selected industries to the welfare of the community.

E. Recognize why purposeful work is important to man's happiness.

Write a paper on what makes one happy and unhappy.

Interview an industrial worker regarding boredom in doing a routine task in industry.

Participate in a small group discussion on the value of work in one's life.

Junior High Level

At the Junior High Level, learning experiences in industrial arts will be directed toward exploration in four major clusters: graphic communications, energy and power, construction and manufacturing. Activities will be directed toward the student's exploration of the historical contributions, present practices, and future potentials of industry and technology. A viable program will enable the student to become actively involved with the role of industrial production, communication, and energy systems to our contemporary way of life.

KNOWLEDGE LEVEL-COGNITIVE DOMAIN

(Energy and Power)

Selected Student Competencies	*Sample Learning Activities*
Experiences and activities at the Junior High Level will enable the student to:	
A. Identify and design an organizational structure of man and machines for a typical energy-power industry.	Form a flow chart of a chosen power related industry.
B. Distinguish between duties and responsibilities of different personnel levels in industrial organization.	Visit an industry, observe, interview, compile and summarize specific duties and responsibilities of different personnel in the industry.
C. Recall and use industrial-technical energy-power terms in conversation and writing.	Prepare and present a technical report.
D. Identify and distinguish between the common methods of energy-power conversion, transmission, and consumption.	Trace the power flow of electricity production through consumption in the home. Trace power flow through an automobile.
E. Generalize from related information man's dependence on energy-power.	Outline a student's daily dependence on various sources of energy-power in a typical day.
F. Identify the problems technology needs to solve concerning economics, ecology and safety, and energy power conversion, transmission and consumption.	Visit a power generating plant and identify possible environmental problem areas.
G. Demonstrate skills and techniques in class useful for general maintenance and repair of energy and power devices.	Disassemble electric generators and motors and 2 and 4 cycle small gas engines, and experiment with electrical producing and transmission systems.
H. Be familiar with the use of basic components for developing, transmitting, and controlling power.	Experiment with various electrical producing devices.

I. List and describe the main job requirements for a career in one of the occupations related to the power and energy field.	Interview a power and energy worker and summarize job entrance requirements from this interview. Use the *Dictionary of Occupational Titles* to find career information.
J. Describe a variety of basic processes and job skills related to occupations in the power and energy field.	Organize data from interviews and D.O.T. research.
K. Identify in verbal discussion or writing the clusters of jobs related to power conversion and use.	Groups can make a career interview outline. Survey the local community and list specific jobs related to the energy field.

SKILL LEVEL-PSYCHOMOTOR DOMAIN

Selected Student Competencies	*Sample Learning Activities*
Experiences and activities at the junior high level will enable the student to:	
A. Manipulate an apparatus for demonstrating energy sources, conversion, transmission, and consumption of power.	Construct small model rockets and demonstrate their use. Construct an experimental battery.
B. Apply knowledge and skills toward converting power.	Write a program for personal conservation of energy.
C. Operate basic test and measuring devices used in energy systems.	Measure the characteristics of electrical and fluidic systems.
D. Locate and use resources on energy-power training programs.	Gather information from the D.O.T. and a variety of other sources on careers in the energy-power cluster. Interact with guest speakers from trade schools, business, and industry.
E. Identify high school and post-high school training programs in energy-power.	Plot a personal plan of procedure for acquiring the skills and knowledge for entrance into tentative occupation.

ATTITUDINAL LEVEL-AFFECTIVE DOMAIN

Selected Student Competencies	*Sample Learning Activities*
Experiences and activities at the junior high level will enable the student to:	
A. Organize and list in order criteria for choosing and buying power devices.	Compare small electrical appliances and tools at local retail stores.
B. Develop an appreciation for industrial power devices.	Perform a maintenance activity on power devices found in the shop.
C. Appreciate the effect of recent state, local, and national government ecological standards on the use of energy-power systems.	Review and compile local and state standards presently affecting the energy-power industries.
D. Relate how technology can solve a problem while creating other problems.	View and discuss a film on how an energy producing industry has solved a major ecological problem relating to its operation.
	Construct a small-scale working model of a smoke stack pollution control filter.
E. Display personal and group safety when working around energy-power systems.	Participate in a safety survey.
F. Recognize that all jobs in this career field are important and that work has self-gratifying value.	Study the relationship and dependence of specific jobs on others.
G. Experience the value of making a tentative career choice and gaining competency in its work requirements.	Conduct a tape recorded interview with an individual in the community in the area of the tentative occupational choice.
	Exploratory observation on the job with an employee engaged in the area of career choice.

KNOWLEDGE LEVEL-COGNITIVE DOMAIN

(Construction)

Selected Student Competencies	*Sample Learning Activities*
Experiences and activities at the junior high level will enable the student to:	
A. Relate in-school experiences in construction technology with construction projects in the community, state, and world.	Take field trips to various construction projects.
	Engage guest lecturers from the construction industry.

B. Identify major types of tools, equipment, and materials and how they are used in the construction of a project on a site.

C. Identify and describe the functions of management technology as it relates to the construction of a project on a site.

D. Identify and describe the functions of production technology as they relate to constructing a project on a site.

E. Identify and describe the functions of personnel technology as they relate to construction of a project on a site.

F. Synthesize the construction practices of management, personnel, and production as they relate to the construction of a project on a site.

G. Recognize and cite evidence of the effects of construction technology on society.

Construct a scaled-down section of a house, garage, or farm building.

Plan activities such as: (a) formulating project ideas, (b) researching site conditions, (c) designing a construction project, and (3) determining costs, specifications and making working drawings.

Organize activities such as: (a) structuring a mock construction company, and (b) supplying the company with personnel and equipment.

Control activities such as: (a) playing the role of foreman, engineer, architect, inspector, and contractor.

Engage in preprocessing practices such as storing and handling materials.

Perform processing practices such as: (a) separating (sawing, drilling, screening sand, cutting metal; (b) combining (mixing concrete, painting, plastering, soldering copper tubing, using mechanical fasteners (nails, screws, rivets); (c) forming (bending sheetmetal for heating duct, bending conduit).

Organize into small groups to facilitate efficient personnel practices by assigning roles or tasks to individuals within the group.

Engage in role-playing activities that involve hiring, training, advancing and possibly firing.

Participate in a series of activities vital to the successful completion of a constructed project from its inception to its completion.

Construct a bulletin board display on technological advancements in the construction industry.

Invite a speaker from local Chamber of Commerce, construction concern, or city planning commission.

Participate in a group project which simulates the development of a community from its primary construction beginning through eventual ecological and urban renewal stages.

H. Demonstrate a basic knowledge of the variety of career opportunities and job requirements in the construction industry.	Read books, pamphlets and related printed material on occupations and professions in the construction industry. Participate in lab activities designed to reflect job roles which parallel those in construction related vocations, and discuss the experiences. Talk with people who are involved in construction and, via seminars, present oral reports on their jobs, qualifications, and working conditions.
I. Recognize levels of construction-related work responsibility and their varying knowledge and skill demands.	Participate in role-playing activities which simulate varying degrees of job responsibility and skill involving decision making, problem solving, leadership, followership, and dexterity.
J. Strengthen techniques of developing interpersonal relationships necessary to a successful and rewarding engagement in any vocation or professions.	Solve technical or personnel problems by discussion with peers while using inquiry techniques with minimal teacher assistance.

SKILL LEVEL-PSYCHOMOTOR DOMAIN

Selected Student Competencies	*Sample Learning Activities*
Experiences and activities at the junior high level will enable the student to:	
A. Demonstrate a basic proficiency in the safe handling of tools and techniques used in the construction industry.	Observe demonstrations then practice using basic construction tools and materials in a safe manner. Construct a scaled-down version of a house, garage, farm building, or concrete form.
B. Apply principles of planning and design, considerations of materials to prepare working drawings.	Solve a design problem. Interpret a set of working drawing. Write a basic set of specifications.
C. Solve meaningful problems and relate the problem-solving processes to other in-school problematic situations.	Solve a problem via joint effort of a small group. Utilize reference material to solve a problem. Participate in an educational game which requires exercising the decision-making process.

ATTITUDINAL LEVEL-AFFECTIVE DOMAIN

Selected Student Competencies	*Sample Learning Activities*
Experiences and activities at the junior high level will enable the student to:	
A. Exhibit a willingness to discuss technical aspects of construction with other students, parents, and teachers.	Participate in a group discussion on a technical aspect of construction such as the desirable characteristics of various types of building materials or construction processes.
	Complete a home assignment involving joint effort with parents. Example: determining the adequacy or inadequacy of the room sizes in the home.
B. Narrate the value of interaction with peers as a means to the solution of a technical problem.	Solve a technical problem common to a group through participative interaction.
C. Formulate opinions regarding interests and aptitudes relative to occupations existing in the construction industry.	Participate in a variety of activities which simulate or parallel work roles while providing options for continuing in a given role or selecting other roles.
	Participate in a rap session with the school counselor; Topic: "Construction Careers For Me."
D. Exhibit a positive attitude toward safe working conditions and practices while using tools and materials.	Make safety posters on displays applicable to construction.
	View and discuss a safety film.
E. Express positive opinions concerning the influence of technology on society.	Participate in a debate involving the impact of technology on society (ecology, industry, urban renewal, etc.)
	Engage in an activity which involves using primitive tools, and compare them with modern tools.
F. Demonstrate an understanding and appreciation of the value of work in one's life.	Interview (by phone or personal contact) individual craftsmen or professionals from the construction industry. From this interview determine the advantages and disadvantages of the individual's job as they relate to his life style; and, in a seminar setting, present this data to peers.

KNOWLEDGE LEVEL-COGNITIVE DOMAIN

(Manufacturing)

Selected Student Competencies	*Sample Learning Activities*
Experiences and activities at the junior high level will enable the student to:	
A. Identify the raw materials necessary to the manufacture of named products.	Investigate how iron ore is converted to steel.
B. Identify the management practices which are necessary for the manufacturing of a product.	Develop an operation and flow diagram for mass producing and assembling an item previously made by custom production.
C. Identify the different methods of separating, forming, machining, assembling and finishing materials.	List examples of methods of forming, machining, finishing and assembling materials.
	List how different materials are cut, bent, and fastened together.
D. Describe the need for tooling in mass manufacture.	Identify the tooling needs for mass producing an object, and differentiate between the needs for mass production and custom production.
E. Describe the need for production control.	Participate in a simulation of controlled production.
	Participate in a variety of experiences which involve shearing, forming, machining, assembling and finishing various types of materials.
F. Exhibit basic knowledge of career opportunities in the manufacturing field.	Investigate jobs from various sources; i. e., printed literature, industrial visitations and interviews.

SKILL LEVEL-PSYCHOMOTOR DOMAIN

Selected Student Competencies	*Sample Learning Activities*
Experiences and activities at the Junior High Level will enable the student to:	
A. Apply measurement systems used in the manufacture of a product.	Practice measuring selected objects with English and Metric systems.
B. Use a managed production system to produce a product.	Diagram a management system necessary for constructing a previously manufactured prototype.
C. Perform the basic skills in several areas of manufacturing.	Use material processing equipment for finishing products.
	Make a product that involves cutting, bending, drilling and assembling.

D. Demonstrate methods of separating, forming, machining, assembling of materials and products.	
E. Demonstrate techniques for securing a job.	Simulate job interviews in the classroom. Write letters of job applications. Take psychomotor tests.

ATTITUDINAL LEVEL-AFFECTIVE DOMAIN

Selected Student Competencies	*Sample Learning Activities*
Experiences and activities at the Junior High Level will enable the student to:	
A. Discuss the safety measures necessary in a manufacturing plant.	View industrial safety films. Practice good safety habits and attitudes.
B. Relate the necessity of selling, distributing, and servicing a manufactured product.	Sell and distribute the student company's mass produced product.
C. Plan wisely before producing goods and services.	Tour an industry to see how they plan for production.
D. Describe the advantages of different finishes.	Test and evaluate various types of finishes.
E. See the necessity for a variety of jobs in manufacturing fields.	Construct a flow chart depicting how jobs inter-relate and depend on one another.

KNOWLEDGE LEVEL-COGNITIVE DOMAIN
(Graphic Communications)

Selected Student Competencies	*Sample Learning Activities*
Experiences and activities at the Junior High Level will enable the student to:	
A. Compare the merits and weaknesses of numerous types of composition.	Collect examples of composition from different types of composition machines and critique their weaknesses and values.
B. Recognize basic reproduction processes used in industrial applications of technical graphics.	Identify reproductions produced by various processes.

C. Use properly the nomenclature associated with Graphic Communications.	Use properly the terminology associated with graphic communications in daily conversation within the laboratory.
D. Interpret standardized drafting symbols when they are presented in the form of a drawing.	Produce a cardboard or styrofoam model from a dimensioned drawing. Answer questions pertaining to a drawing when presented with a print.
E. Compare the occupational requirements and benefits for at least four jobs in each of the following areas of Graphic Communications: research and development, design, drafting, graphic reproduction and packaging.	Have each member of the class interview two employees in one of the areas of graphic communications, the similarities and differences in job requirements and benefits.
F. Identify at least fifteen industrial occupations in the Graphic Communications cluster.	Play "Twenty Questions" with some students picking an occupation and the other members of the class asking questions, attempting to identify the occupation.

SKILL LEVEL-PSYCHOMOTOR DOMAIN

Selected Student Competencies	*Sample Learning Activities*
Experiences and activities at the Junior High Level will enable the student to:	
A. Compare and contrast the industrial applications of the basic printing processes.	Prepare a display using examples of the basic printing processes.
B. Demonstrate the interrelationship of photography with drafting and graphic arts as used in industry.	Produce a photodrawing. Produce a film positive half-tone for photo silk screening.
C. Produce copies using image reproduction processes generally found in business and offices.	Produce notes and flow charts from the management of a class "corporation" using a spirit duplicator. Produce presentation materials using a thermofax machine.
D. Discuss the primary responsibilities of those necessary to the production of a printed document in industry.	Hold a small group discussion regarding the production of a printed document in industry resulting in the making of a flow chart showing a document's route.
E. Interpret the responsibilities of those necessary to the design and production of an industrial product.	Divide the class into small groups and establish a corporate structure. Design a product, assigning individual responsibilities according to the design phase of the predetermined corporate structure.

F. Demonstrate proper use of the four primary printing processes.	Prepare a photo silk screen for printing a package design. Prepare business cards for the management of a class "corporation." Duplicate with an offset duplicator presentation materials for a product.
G. Produce continuous-tone photographic positives and negatives.	Shoot and print pictures of members of a class "corporation" and prepare them to be used as identification badges. Prepare a microfilm copy of a drawing.
H. Apply basic processing concepts of orthochromatic photography.	Prepare line negatives for stripping of an offset plate.
I. Demonstrate a knowledge of how to assemble printed material.	Produce a note pad for the members of a class design team. Prepare an instruction or assembly booklet for a product.
J. Demonstrate effective means of conveying an idea using presentation materials.	Make a product design idea presentation to the class.
K. Apply the principles of Graphic Communications to produce a package for a product.	Prepare a prototype package for a designed product.
L. Apply the principles of design to a given problem.	Given a problem, design a satisfactory solution employing the principles of design.
M. Apply the theories of visual organization.	Given a specific product, design an advertisement to portray the product in a popular magazine.
N. Draw a freehand sketch using proper sketching techniques to depict an idea.	Properly produce sketches in connection with other design problems.
O. Produce drawings following standardized procedures capable of being used to produce a product.	Draw production drawings from prototypes and design sketches.

ATTITUDINAL LEVEL-AFFECTIVE DOMAIN

Selected Student Competencies	*Sample Learning Activities*
Experiences and activities at the Junior High Level will enable the student to:	
A. Discuss critically the merits and weaknesses of an existing industrial design.	Critique the design of a product from the home, indicating its weaknesses and merits.

B. Describe the merits of the common types of pictorial representation.	Produce examples of each of the common types of pictorial representations and list applications for each type.
C. Generalize the importance of design principles developing a product.	Collect examples of poor design and hold a class discussion regarding students' reaction toward the examples shown.
D. Demonstrate an understanding of the importance of individual occupations to the whole of Graphic Communications.	Conduct radio tape interviews with a classmate (each student interviewing another student.) Explain how you feel about "your" job and its importance to the total Graphic Communications cluster.
E. State a positive attitude towards a posible career in some aspect of Graphic Communications.	Write a paper on: "What job would I like to have in the Graphic Communications field?"

Senior High

At the Senior High Level, learning experiences in industrial arts will be directed toward exploration in depth and beginning specialization regarding the present practices and future developments occurring in contemporary industry and technology. In-depth exploration will also be afforded the student regarding industrial/technological careers. Learning experiences at the Senior High Level will be available to the student in a variety of industrial/technological content areas represented in the basic systems of: Production, Energy, and Communications. Recommended offerings include: Design-Drafting; Graphic Arts; Construction; Woods; Metals; Plastics; Power; Electricity/Electronics; and Research and Development.

KNOWLEDGE LEVEL-COGNITIVE DOMAIN
(Graphic Arts)

Selected Student Competencies	*Sample Learning Activities*
Experiences and activities at the Senior High Level will enable the student to:	
A. Define the major elements of production and consumption of goods and services; including design of the product, composition of the materials, purchasing materials, processing and delivery of materials.	Design, evaluate, produce, and market a mass production product.
B. Analyze and explain the roles of management and labor as they relate to graphic arts technology.	Analyze the roles played by management and labor to arrive at a finished product after participating in a mass production product.
C. Assess abilities and interest as they relate to careers in graphic arts technology.	Study job responsibilities and opportunities in the printing industry in the locale of the school.

D. Formulate concepts of jobs and salaries in the graphic arts as they relate to career goals.	Study the salaries earned by persons in printing, after interviewing employers in local industries.
E. Identify the major types of materials and supplies used in graphic arts technology.	Participate in class field trip(s) to various printing concerns that represent at least two major areas of the graphic arts.
F. Recognize the equipment used in graphic arts technology.	Complete a tool and equipment identification test that covers the machinery and tools that are used in your facility.
G. Evaluate the elements of good design and interpret printing needs through problem-solving techniques.	Use overhead transparency set (from DCA or other) to illustrate equipment design, theory and materials usage during class discussions and demonstration. See reference list for details on transparencies.
H. Broaden concepts of printing technology by comparison of printing processes with graphic products.	Work in conjunction with another class that produces a product, designing, advertising, packaging and other product related layout.
	Collect samples of printed materials that represent at least three of the major areas of graphic arts.
	Participate in a class discussion of printing methods, cost factors, and quality control.

SKILL LEVEL-PSYCHOMOTOR DOMAIN

Selected Student Competencies	*Sample Learning Activities*
Experiences and activities at the Senior High Level will enable the student to:	
A. Demonstrate the safe use of equipment, supplies, materials, and processes that are related to graphic arts technology.	Successfully complete safety tests covering machine operations and general attitudes.
B. Increase proficiency through the use of the materials, equipment, and techniques related to the printing industry.	Make a line negative, strip the negative, and use the flat to expose a plate.

C. Analyze processes and techniques by combining, contrasting, and evaluating printing problems as they relate to graphic arts technology.	Shoot a half-tone negative(s) and properly strip a flat containing both the half-tone and a line negative for burning offset plate. Make a direct image master; single or multicolor. Make a mechanical master using a typewriter. Design a bumper sticker or t-shirt layout that is to be used in the direct or indirect photographic silk screen process. Design at least one letterpress project; which should include forms involving ruling, perforating, and/or bordering. One or two of the finished prints could be thermographed.

ATTITUDINAL LEVEL-AFFECTIVE DOMAIN

Selected Student Competencies	*Sample Learning Activities*
Experiences and activities at the Senior High Level will enable the student to:	
A. Formulate positive opinions regarding occupations in the graphic arts area.	Write a technical report on an Occupation in the graphic arts field that appeals to the student's interests and abilities.
B. Exhibit a willingness to discuss technical aspects of graphic arts technology with other students.	Demonstrate machine operation or tool manipulation in an area of graphic arts to a fellow student.
C. Generate a positive attitude toward equipment operation and safe operating procedures.	Demonstrate the use of at least one piece of equipment to the instructor for evaluation.
D. Discuss the positive and negative aspects of various graphic arts positions as they relate to career outlooks.	After assessing the job opportunities and responsibilities in general, discuss the positive and negative aspects of various graphic arts positions as they relate to the student's career outlook.
E. Display an awareness of the graphic arts industry's trends which reflect current and future vocational employment practices.	

KNOWLEDGE LEVEL-COGNITIVE DOMAIN

(Construction)

Selected Student Competencies	*Sample Learning Activities*
Experiences and activities of the Senior High Level will enable the student to:	
A. Make investigations into the role that industry plays in manufacturing products for construction.	Visit a construction site and list the components which were prefabricated in an industrial plant.
B. Describe the process for custom producing a house.	Write a report on pre-cut or pre-fabricated houses.
	Obtain answers to questions on a study guide by analyzing a set of working drawings.
C. Read basic working drawings, prints, and become knowledgeable of basic kinds of specifications used in construction.	Make a list of symbols, scales, and commonly used methods to communicate ideas in construction.
D. Identify and select what may be considered to be an acceptable construction site.	Visit building sites, then write a report.
E. Express knowledge of plot planning and layout techniques.	Make a priority listing of factors considered essential to the location of the student's future home.
F. Describe basic procedures concerning excavations and foundations.	Observe an excavation.
	Build a model which will demonstrate excavation and foundation construction.
G. Identify common masonry terms, materials and tools.	List common masonry materials and tools used in foundation construction. Use common masonry terms in describing the process to the instructor.
H. Narrate knowledge of construction framing techniques.	Obtain and analyze plumbing, heating, and air-conditioning specs.
	Participate in construction of a house module, garage, or similar structure using various framing techniques.
I. Describe plumbing, heating, electrical and air conditioning requirements as they relate to construction methods and technology.	Study the NEC and local electrical code, then inspect an installation.
	Assist in installing mechanical and electrical devices in a module or actual building.
J. Explain interior and exterior finishing requirements as they relate to the construction industry.	Visit finished construction sites, then report what was observed in terms of interior and exterior finishing methods and materials.
K. Apply the basic techniques used in construction estimating.	Analyze actual construction estimates. Develop an estimate of a selected construction job.

L. Investigate the various occupations dealing either directly or indirectly with the construction industry.	Make a survey of construction jobs.
M. Examine the job opportunities involved with all phases of construction technology.	Select some jobs that are interesting and make a study of preparation needed for them.

SKILL LEVEL-PSYCHOMOTOR DOMAIN

Selected Student Competencies	*Sample Learning Activities*
Experiences and activities of the Senior High Level will enable the student to:	
A. Apply information found on working drawings and blueprints.	Make a blueprint of a construction related job.
B. Perform the various tasks required and involved with plot selection.	Select a suitable plot for a possible construction project, survey it and make a plot plan.
C. Demonstrate an ability to use construction materials and tools with skill and safety.	Participate in the framing and finishing of a building project or model that will exemplify building methods, procedures, and techniques.
D. Perform the basic construction framing techniques.	Plan and perform skills relating to plumbing, heating, electrical and air conditioning construction.
E. Demonstrate ability to apply knowledge of plumbing, heating, electrical and air conditioning as they relate to construction.	
F. Select and apply compatible interior and exterior finishing materials in terms of their relationship to the entire construction plan.	Make test panels of various types of finishes and subject them to various tests of heat, moisture, and impact. Apply finishes to interior and exterior walls. Have others evaluate.

ATTITUDINAL LEVEL-AFFECTIVE DOMAIN

Selected Student Competencies	*Sample Learning Activities*
Experiences and activities of the Senior High Level will enable the student to:	
A. Show an appreciation for what industry has to do before a product can become marketable.	Participate in a class discussion regarding hidden tasks and costs in producing and marketing a product. Collect information from contractors, foreman, and workers that show the relationship of attitudes to success or failure in the construction industry.

B. Exhibit a willingness to solve the technical problems relating to construction technology.	Participate in "shop talks" relating to technical problems which arise in the construction of a building, module, or scale model. Visit the city engineer or mayor and discuss the pros and cons of building codes.
C. Gather data dealing with the fact that today's worker may have to change jobs a number of times during his working career.	Visit employment agencies to determine the number of times persons have changed jobs.

KNOWLEDGE LEVEL-COGNITIVE DOMAIN

(Power)

Selected Student Competencies	*Sample Learning Activities*
Experiences and activities of the Senior High Level will enable the student to:	
A. Recall, describe, or discuss the development of thermal, mechanical, and fluid power.	Assist in developing a bulletin board display.
B. Determine some of the economic and social effects that thermal, mechanical, and fluid power have had on man.	Write a paper on the development and use of mass production in the automotive industry. Participate in a discussion on the social effects of transportation and power.
C. Describe the career opportunities available in automotive sales and service.	Study the careers in automotives, then present oral reports to the class on career opportunities.
D. Make a selection of job options which are best suited to his needs and abilities.	Evaluate personal qualifications in order to determine a successful preparation.
E. Determine the working conditions in automotive service facilities.	Visit and report on the cleanliness, lighting, ventilation, special tools, and testing equipment of several local service station shops.
F. Recall, describe, or critically discuss the internal combustion engine principles.	Investigate reciprocating and rotary engine principles. Study relationship of valve timing to reciprocating engine principles.
G. Describe the automotive electrical and fuel systems.	Prepare diagrams of the basic automotive electrical systems. Color diagrams of basic carburetor circuits.
H. Critically discuss the principles of power trains and suspension systems.	Review the principles of simple machines, single and compound planetary gear systems, or steering geometry and describe their operation to the instructor. Review the principles of hydraulics and pneumatics as they relate to automatic transmissions and braking systems.

I. Recall, describe, or critically discuss principles of thermodynamics.	Study the laws governing heat, engine temperature control, and personal comfort control.
J. Demonstrate and exhibit the critical selection of a new or used car.	Interview garage service managers on the application of warranties. Discuss with a banker or finance company representative the financing of a car. Make a checklist of items to look for when purchasing a car, such as: what kind of car to buy, options, interior, and exterior.
K. Demonstrate and exhibit the critical selection of tires.	Study ply design, ratings, and load limits, tread design, and car owner's usage. Study tire warranties.

SKILL LEVEL-PSYCHOMOTOR DOMAIN

Selected Student Competencies	*Sample Learning Activities*
Experiences and activities of the Senior High Level will enable the students to:	
A. Demonstrate or exhibit the principles of internal combustion engines.	Participate in the complete overhaul of an internal combustion engine.
B. Demonstrate or exhibit the principles of automotive electrical and fuel systems.	Diagnose and remedy simulated problems on test engines, ignition systems, charging systems, and starting systems. Perform service on lighting and electrical accessory systems and rebuild a carburetor.
C. Demonstrate or exhibit the principles of the automotive power train and suspension system.	Perform routine adjustments and service on clutches, standard and automatic transmissions, drive lines, differentials, springs and shock absorbers, brake drums, disc power brake systems. Perform basic service on steering systems and alignment.
D. Demonstrate or exhibit the principles of heat transfer.	Solve induced problems on lab setups of cooling systems, heating systems, and air conditioning units.
E. Demonstrate or exhibit safe practices in working with power systems, tools and equipment.	Read materials, observe demonstrations, participate in class discussion, and practice proper procedures regarding safe practices and precautions in the power lab.
F. Demonstrate or exhibit the ability to prepare a repair order.	Listen to customer complaints and make accurate analysis and diagnosis of problem.
G. Demonstrate or exhibit the ability to perform a tune-up with expertise.	Follow a well organized, step-by step tune-up procedure.

ATTITUDINAL LEVEL-AFFECTIVE DOMAIN

Selected Student Competencies	*Sample Learning Activities*
Experiences and activities of the Senior High Level will enable the student to:	
A. Demonstrate a willingness to exhibit efficient, expedient use of time.	Use the flat-rate manual to estimate time required to perform various servicing tasks.
	Use applicable information manuals and specification sources.
B. Demonstrate employable work habits and attitudes.	Simulate employer-employee job application interviews.
	During lab work, exhibit initiative and independence.
C. Exhibit a willingness to use safe work habits and to promote safety consciousness.	Wear safety glasses; use jack stands, keep the floor clean; use air pressure properly.
D. Show a willingness to use good work habits of orderliness, cleanliness, and care of property.	Use fender covers; keep tools in proper place and condition; use special tools.

KNOWLEDGE LEVEL-COGNITIVE DOMAIN

(Electricity/Electronics)

Selected Student Competencies	*Sample Learning Activities*
Experiences and activities of the Senior High Level will enable the student to:	
A. Narrate basic concepts of the election theory.	Study materials and participate in class discussions on the election theory.
B. Identify most common electrical components and circuits.	Practice proper terminology in all lab activities.
C. Perform basic mathematical calculations involving quantitive.	Study procedures and practice assigned problems.
D. Interpret general schematic diagrams.	Diagram general circuits. Find the answers on a study guide from accompanying diagrams.
E. Explain the needs for a systematic and safe procedure in setting up experimental circuits and servicing equipment.	Follow instructions and written procedures in trouble-shooting, servicing equipment, and setting up instructional circuit boards.
F. Examine various electrical and electronic careers in relation to abilities, education, and work activity.	Compare electrical and electronic occupations in specific industrial and career clusters.
	Relate knowledge and skills needed in a specific career with respect to continuous or terminal preparation.

G. Explain the theory of operation in AC and DC circuits of Ohm's Law, Kirchoff's Law, and Watt's Law involving resistors, coils, capacitors, and transistors.	Confirm by experiments that the sum of the voltage drops in a closed loop is zero. Demonstrate effects of power dissipation in the form of heat. Make a drawing of a sinusoidal wave showing the peak, rms, and average values. Determine the phase relationship of voltage and current in RC and RL circuits.
H. Develop a knowledge of technological information and principles of electricity and electronics.	Identify electrical and electronic components used in electrical products and distinguish the theory of operation. Interpret effects of related components in amplifiers, power supplies, oscillators, etc.

SKILL LEVEL-PSYCHOMOTOR DOMAIN

Selected Student Competencies	*Sample Learning Activities*
Experiences and activities of the Senior High Level will enable the student to:	
A. Develop proficiency in the safe use of electrical test equipment and methods of solving circuit problems.	Utilize test equipment, tools, and materials for repair or fabrication. Practice a logical sequence for construction of products or servicing of electrical equipment.
B. Exhibit insight into the application of technology to problems of electrical design and servicing.	Propose possible solutions to problems of repair and/or construction. Design and build experimental circuits.
C. Evaluate the value of manufactured products produced by the electricity/electronics industry to the future needs of industry and society.	Participate in a group scenario of future applications of electronics in our society.
D. Display proficiency in functioning as an intelligent consumer in the selection, purchase, use, and maintenance of the products of the electrical industry.	Conduct a survey of various brands of a commercial electrical device and make comparisons of the quality and costs.
E. Apply the use of an oscilloscope to verify signal patterns of various stages in consumer products.	Demonstrate signal comparisons in amplifiers, oscillators, etc. Compare input to output for observation distortion. Analyze the use of the oscilloscope as an instrument for solving circuit problems.

ATTITUDINAL LEVEL-AFFECTIVE DOMAIN

Selected Student Competencies	*Sample Learning Activities*
Experiences and activities at the Senior High Level will enable the student to:	
A. Examine personal goals and desired life style to occupational areas in the electricity/electronics fields.	Write a paper on the implications of electrical careers to the student's desired future life style. Ask an electrical engineer from the local utilities company to visit the class to discuss his work and its relation to the area of power distribution.
B. Describe the importance of following regulations in the installation of electrical wire and components.	Discuss a portion of the National Electrical Code. Observe conditions of improper use and determine areas of responsibility.

KNOWLEDGE LEVEL-COGNITIVE DOMAIN

(Plastics)

Selected Student Competencies	*Sample Learning Activities*
Experiences and activities at the Senior High Level will enable the student to:	
A. Recognize how the plastics industry related to the total industrial-technological community in the production of goods and services.	View a film dealing with the use of plastic products in manufacturing and construction, and also in the communications and energy fields. Discuss the basic chemistry of polymers.
B. Investigate and analyze the plastics industries' impact on the ecological balance, the utilization and conservation of natural resources, and the recycling capabilities of plastic materials and goods.	Demonstrate and/or discuss the regrinding and remolding of scrap and/or rejected products. Form pro and con teams to debate the ecological impact of plastics.
C. Describe by narration the basic principles of the plastics molding processes.	Examine commercial products made by different molding methods. Discuss characteristics of plastics materials and their suitability as a product.

D. Discuss critically the present status and potential of plastics in our society.	Develop a visual chart showing the growth of the plastics industry in comparison with other major industries.
E. Explain the industrial processes employed to form and fabricate plastics materials into functional items.	Use molds available in the laboratory and mold products following the procedures for different processes and machine operations. Take a field trip to a plastics industry to observe molding and production methods.
F. Compare and contrast the kinds, composition, and characteristics of plastics.	Make a collection of hollow plastics containers and examine each for process, material, and suitability for use intended. Write to a major manufacturer of plastics polymers to secure literature and specifications, then report the finding to the class.
G. Recognize the possible employment opportunities in the plastics field, locally and nationwide.	Conduct an occupational analysis of plastics occupations in Iowa. Interview a member of the Society of Plastics Engineers on training, education, and employment in the plastics field.
H. Discuss the education and training needed to qualify for employment in the plastics field.	Participate in a class seminar on courses that should be taken to prepare for a chemical engineering or plastics technician career.

SKILL LEVEL-PSYCHOMOTOR DOMAIN

Selected Student Competencies	*Sample Learning Activities*
Experiences and activities of the Senior High Level will enable the student to:	
A. Demonstrate or exhibit safe practices in the handling of plastics materials while working with plastics processes and equipment.	Experiment with mold-making using various types of materials.
B. Demonstrate or exhibit the ability to plan and construct limited dies and molds for molding, forming, and fabricating plastics.	Collect samples of molding compounds then vacuum form a visual display board and heat-seal the samples within the display.

C. Demonstrate or exhibit problem-solving techniques in the selection of suitable plastics materials for given uses and forming techniques.	Select an article to be embedded and compression mold it in acrylic molding compound. Then, embed a similar article in liquid casting resin. Compare the materials, processes, cost, and the resulting product. Make limited production runs, using different processes, then compare them as to adaptability of these processes to mass production techniques. Trouble-shoot or analyze poor quality items produced in the laboratory.

ATTITUDINAL LEVEL-AFFECTIVE DOMAIN

Selected Student Competencies	*Sample Learning Activities*
Experiences and activities of the Senior High Level will enable the student to:	
A. Express a positive attitude toward employment opportunities in the plastics industry.	Participate in a question and answer session with a personnel director from a local or regional plastic industry on employment opportunities in the plastics field.
B. Operate equipment, handle plastics materials, and utilize processes in a safe and orderly manner.	Follow instructions and safety procedure in setting up and operating equipment, and in handling materials in the lab. Identify plastics using burn test techniques.
C. Further investigate and explore the materials, processes and products of the plastics industry, and its impact on our society.	Contribute to discussion in a seminar exploring the plastics industry's possible impact on students within the class and on society. Visit an industry which produces plastics products.
D. Appreciate the knowledge, skills and aptitudes necessary for different levels of employment in the plastics field.	Ask pertinent questions of an employee from a local or regional plastics industry concerning employment opportunities and requirements in his industry.
E. Exhibit good work habits, respect for and cooperation with associates.	Participate in a group project such as designing, fabricating and using a special mold. Carry out individual responsibilities in a mass production venture with the rest of the class.

KNOWLEDGE LEVEL-COGNITIVE DOMAIN

(Metal)

Selected Student Competencies	*Sample Learning Activities*
Experiences and activities at the Senior High Level will enable the student to:	
A. Identify the raw materials needed to make ferrous and nonferrous metals, their sources and how they are transformed into usable products containing certain characteristics.	Express knowledge of metals by correctly answering questions on an objective test.
B. List the raw materials needed to make aluminum, their sources and how they are transformed certain characteristics.	Demonstrate knowledge of aluminum, correctly answering questions in a learning activity package.
C. Differentiate between some of the many metal machines used in processing metals and explain the requisites of these machines.	Prepare ads to buy or sell equipment used in the metals industries.
D. Describe the relationship between speed and feed and apply this to safe and correct operation of metal processing machines.	Calculate settings for operation of metal processing machines to perform selected processing operations.
E. Apply the process of heat treatment as it applies to plain carbon steels.	Conduct tests of heat treating methods on samples of carbon steel.
F. Identify those properties which create the need for steel classifications and interpret the data from resource information.	Given a list of specific metal classification numbers, identify the source of production and specific metal contents.
G. Identify methods for joining metal together.	Join metal pieces using the following processes: riveting, soldering, welding, and hand grooving.
H. Interpret welding symbols found on blueprints of products fabricated by welding.	Interpret a blueprint of an object to be welded specifying its limitations, and formulate the welding sequence.
I. Differentiate between iron and steel.	Discuss critically the advantages and disadvantages of iron and steel.
J. Identify files according to their length, shape, type of cut, and coarseness of cut.	Read about the use the basic files noting differences in length, shape, type of cut, and coarseness of cut.
K. Recognize the possible employment opportunities in the metals industry.	Visit a local or regional metals industry and write a report briefly describing different types of jobs which exist in that industry.

SKILL LEVEL-PSYCHOMOTOR DOMAIN

Selected Student Competencies	*Sample Learning Activities*
Experiences and activities at the Senior High Level will enable the student to:	
A. Compare the quality of a weldment.	Perform face and root bends on a guided bend tester.
B. Use the spark testing technique to identify high carbon from low carbon steel.	Identify types of steel using the spark testing technique.
C. Conduct strength and elasticity tests to distinguish limitations between two steels.	Compare different properties of steel by the use of recognized testing equipment and techniques.
D. Analyze and interpret working drawings.	Read dimensions from a working drawing; draw up a list of materials needed to make the specified object; and, determine the tools, equipment, and machining sequence needed for production.
E. Select proper arc welding electrodes.	Interpret the electrode classifications code and select an electrode for a specific welding requirement.
F. Calculate the cost of materials which are sold by the square or running foot.	Analyze a list of materials which are sold either by the square or running foot and calculate the total cost of that material.
G. Apply measuring techniques to the solution of metal processing problems.	Measure machine parts using metric and decimal micrometers.
H. Demonstrate proficiency in the proper and safe operation of metalworking tools, machines and in their treatment of materials.	Safely and correctly perform the operations of facing, drilling, countersinking, turning to a diameter, knurling, and cutting a taper with the compound rest on a lathe.
I. Properly select and use twist drills with safety and skill.	Select the correct drill, speed, and feed for completing a production task.
J. Use decimal and metric equivalent charts.	Convert fractions to decimals, decimals to fractions, and decimals to millimeters.

ATTITUDINAL LEVEL-AFFECTIVE DOMAIN

Selected Student Competencies	*Sample Learning Activities*
Experiences and activities of the Senior High Level will enable the student to:	
A. Exhibit orderly work habits and show consideration for his fellow workers.	In performing lab activities, follow a planned procedure, avoid disturbing other students, return all tools and materials to their proper location.
B. Express positive attitudes toward further experiences in metals technology.	Discuss with the teacher or counselor the opportunities for further education or occupational experience in metals technology.
C. Appreciate the knowledge, skills, and attitudes of personnel in various phases of metal technology.	Analyze similar commercially produced metal products and discuss the human factors which may have contributed to the quality or lack of quality in these products.

KNOWLEDGE LEVEL-COGNITIVE DOMAIN

(Woods)

Selected Student Competencies	*Sample Learning Activities*
Experiences and activities of the Senior High Level will enable the student to:	
A. Evaluate methods and processes employed by industry to produce wood products and conserve our timber resources.	Study the various processes used in industry that relate to wood conservation and science.
	Participate in class discussions concerning the importance wood conservation and science has in industrial production.
B. Examine and study the available information on career opportunities in wood technology and identify a tentative career option.	Using the *Dictionary of Occupational Titles*, identify job possibilities in wood technology.
C. Describe the apprentice and skill levels for major occupational areas in wood products processing and fabrication.	Investigate qualifications and write a report on an area of interest, describing what would be required to achieve personal goals in this area.

D. Describe the activities of a design department in industries applying wood technology.	Investigate informational sources regarding occupational and educational pursuits in drafting, design, or related activities in various industrial establishments utilizing wood technology.
E. Compare and evaluate the various characteristics of good design used in the production of furniture and cabinets.	Study the fundamentals and practices of good design as used in the furniture and cabinet making industries.
G. Solve simulated industrial design or planning problems in the production of a product.	Discuss the relationship of material cost to the design and production of a product.
H. Display proficiency in the evaluation of manufactured products in terms of appropriateness of materials, functionality of design and purpose as well as quality of construction.	Participation in the design and production of a mass-produced wood product.
I. Discuss critically how designing and planning relate to the fabrication of furniture and cabinets in various types of industrial production.	Compare custom made furniture and cabinets to those that are mass produced.

SKILL LEVEL-PSYCHOMOTOR DOMAIN

Selected Student Competencies	*Sample Learning Activities*
Experiences and activities of the Senior High Level will enable the student to:	
A. Solve problems related to commercial types and applications of finishes.	Participate in exercises dealing with the application of finishing methods.
B. Apply the principles of systematic design and planning in the production of a useful project.	Exhibit mastery of the concepts of design through the planning and fabrication of a project.
C. Devise a plan of procedures and operations for repetitive and quantity machining and fabrication of wood products or components of a product.	Select the method of least wasted motion and set up jigs and other devices for repetitive operations.
D. Devise, compare, and estimate the specific industrial applications and operations necessary for the production, in quantity, of a particular product made of wood or related forestry products.	Select, organize, and manufacture a product of wood under industrial specifications.
E. Exhibit proficiency in safely performing a variety of machine and tool operations for processing and shaping wood.	Demonstrate proficiency in the set-up and operation of wood machining equipment and successful complete written and performance safety tests.

F. Investigate and experiment with basic wood machining processes for mass production of a wood product.	Participate in responsibilities dealing with a mass production enterprise activity.
G. Develop the ability to evaluate the applications of the science of wood in the fabrication of industrial products.	Display proficiency in the application of wood conservation and science in the fabrication of a project using processes similar to those used in industry.
H. Evaluate the quality of finishing materials.	Demonstrate the ability to properly use finishing materials in the production of a project, and conduct a self-evaluation of the results.

ATTITUDINAL LEVEL-AFFECTIVE DOMAIN

Selected Student Competencies	*Sample Learning Activities*
Experiences and activities of the Senior High Level will enable the student to:	
A. Display an awareness of the knowledge, skills, and aptitude necessary for different levels of employment in woods industries.	Visit an industry which produces wood products, and critique the sequencing of work followed in their production operations.
B. Express a positive attitude toward employment opportunities in wood industries.	Interview an employee of the local State Employment Office on job opportunities in the area.
C. Further investigate and explore the materials, processes, and products of the wood industry and its impact on our society.	Participate in a seminar activity concerned with exploring the wood industry's possible impact on classmates and on society.
D. Display an awareness of the knowledge, skills, and aptitude necessary for different levels of employment in the wood industries.	View the film, "How to Crack the Establishment," then develop a classroom display on the requirements for employment in a woods industry.
E. Describe the potential career opportunities in wood conservation and science in the year 2000.	View the film, "Future Shock," then develop a graphic display and written presentation on the contribution of the wood industries to our society.

KNOWLEDGE LEVEL-COGNITIVE DOMAIN

(Design/Drafting)

Selected Student Competencies	*Sample Learning Activities*
Experiences and activities at the Senior High Level will enable the student to:	
A. Narrate the contributions which design and the draftsman make, in the development, manufacturing or construction of commercial products.	The student will: Participate in at least one field trip, the primary purpose of which will be to obtain an overview of an entire development and production operation, with specific reference to the role of the draftsman.
B. Analyze vocational opportunities in which design-drafting skills and knowledge are essential or desirable.	Develop a report of an interview with the head of a (local industry) drafting department. Participate in a class discussion led by a practicing engineer or architect.
C. Identify and evaluate the types of equipment and materials used in the major design-drafting industries.	Produce acceptable orthographic and pictorial drawings using equipment and materials similar to that of industry.
D. Interpret drawings made for use in the areas of architectual and machine design.	
E. Narrate and apply the processes of design.	Develop a set of working drawings for an original design project, the degree of completeness and type of presentation to be determined by the complexity and type of problem chosen.
F. Recognize the principles of good design in commercial and student designed products.	Participate in a seminar for evaluating the quality of commercial and student constructed projects.
G. Realistically conceive a specific occupational opportunity and remuneration relative to career goals.	Assist in identifying the principles of good design as evidenced in the products.
H. Assess individual abilities and interests as they relate to current opportunities in design-drafting fields.	Submit, in proper form, a report designed to reflect investigation of one or more design-drafting-related occupations which show a correlation with individual abilities and current interests.

SKILL LEVEL-PSYCHOMOTOR DOMAIN

Selected Student Competencies	*Sample Learning Activities*
Experiences and activities at the Senior High Level will enable the student to:	
A. Evaluate the quality of current drafting room products, from tracing to presentation drawings.	Draw, interpret, and evaluate student-made drawings, including: electrical, machine, architectural and topographical drawings, and technical illustrations.
B. Determine the value and advantages of various types of drafting equipment pertinent to areas under study.	Acquire extensive practice with all basic drafting tools, equipment and supplies; plus some exposure and practice with drafting machines, scales, templates, lettering devices, reproduction machines, and the air brush.
C. Practice efficient and safe use of equipment and materials commonly used in design-drafting related occupations.	Develop a field book data, using a dumpy level and common surveying tools for "running a line" and for establishing elevations on a plot of ground by both polar coordinates and grid patterns.
D. Exhibit proficiency in expressing ideas through graphic representation techniques.	Translate informational data into graphic forms of ieda representation. On all lab activities continually strive to improve techniques such as lettering, line quality, dimensioning and tolerancing.
E. Make competent judgments concerning career choices and level of entry into the job market.	Participate in class discussion of determining factors of level of entry.
F. Make informed judgments in determining the type of post high school training institution which would be most desirable and necessary.	Provide evidence of personal investigation into value of post high school education.

ATTITUDINAL LEVEL-AFFECTIVE DOMAIN

Selected Student Competencies	*Sample Learning Activities*
Experiences and activities at the Senior High Level will enable the student to:	
A. Formulate positive opinions regarding design-drafting and related occupations.	Participate in the playing of "20 Questions," in which each student, in turn, assumes the role of a person employed in a drafting related occupation, answering no more than 20 yes or no questions from other members of the class.
B. Develop accurate value judgments of the types and amounts of training required for various job entry levels.	Interview at least two professional draftsmen inquiring about the requisites for entry and advancement in the design-drafting field.
C. Utilize resource and reference materials essential to major design-drafting areas.	Develop a complete zoning map of the local community, with legend. Correlate this map with zoning regulations applicable to light building construction projects. Use references and resource materials available in the drafting lab or school library to substantiate practices used on drawings.
D. Express a positive self-concept attitude regarding equipment, productive effort, and safety for himself and others.	Participate in a group project involving design or redesign of a product, construction of a prototype, and completion of the necessary working drawing.
E. Evaluate positive and negative aspects of various design-drafting related positions in terms of individual interests and aptitudes.	Visit with persons engaged in design-drafting occupations concerning what they like and dislike about their job.

RESEARCH AND DEVELOPMENT

Research and development enables the student to pursue his areas of interest farther than is normally possible through group instruction in the organized program of classes. Because of our ever changing society and occupational requirements, it is increasingly important that students gain experience in independent learning in order that they may more effectively continue to learn after their schooling is terminated. Equally important is the development of self-concepts and interest in learning that may result from these experiences. In pursuing the answers to his/her own questions, the learner is satisfying a desire to learn in areas of personal relevance.

Research and development encompasses a wide variety of learning activities which may readily be adjusted to the various interests and abilities of students. Examples include researching, experimenting with, and testing of specific industrial materials, processes, or products; creative design; advanced construction activities, and further investigation of potential on all levels; a viable industrial arts curriculum will provide special offerings in independent study on the Senior High Level. This makes for an open-ended curriculum enabling the student to pursue special areas of interest and develop his abilities to the maximum of his potential.

It is recognized that not all students will be able to function well in a self-directed fashion, and some may not desire to participate in research and development. It is therefore recommended that it be an elective offering and that some form of screening applicants take place. It is also recommended that the procedures for conducting research and development be structured. Students will need to know how they are to proceed and what will be expected of them upon completion of the study.

Selected Student Competencies

As a result of the learning experiences involved in conducting research and development the student should be able to:

A. Write a concise statement describing the topic desired to know more about or skills desired to develop.

B. Narrate reasons for wanting to learn about the topic or develop the skills.

C. Define and delimit the student with respect to personal abilities, available time, and resources.

D. List the essential resources (references, materials, equipment, facilities, and people) which may be needed to conduct the study.

E. List the major steps of procedure to be used in the study.

F. Conduct the study in an orderly, safe, and efficient manner.

G. Report findings and conclusions or exhibit the results to others in an organized report or presentation.

Sample Learning Activities

Only a few of the many possible activities are listed. The possibilities are limited only to the imagination of the teacher and student, and their willingness to experiment with new techniques.

General Structuring Activity

Have the student develop a proposal or fill out a contract form including such points as:

☐ Topic description ☐ Reasons for wanting to do it ☐ Definitions and limitations of the study ☐ Resources needed ☐ Major steps of procedure to be followed ☐ Plans for presenting or demonstrating the results ☐ Special considerations such as safety, care of equipment and use of facilities.

Discuss the completed proposal or contract with the student and make recommendations for further progress.

Investigations of Potential Careers

Have the student who wants to know more about the opportunities and requirements of a particular occupation write a report including such topics as:

H. Narrate an evaluation of the independent study experience to the instructor.

I. Express a desire to participate in additional research and development.

☐ Why this occupation for study? ☐ What education is required for it? ☐ What kind of work is involved? ☐ Is an apprenticeship or internship required? If so, what are the conditions? ☐ What are the normal working hours? ☐ What are the average wages? ☐ Where can needed education or training be obtained? ☐ What are the possibilities for promotion? ☐ What dangers or safety hazards are involved? ☐ Is it good occupation for the student?

Technology Interest Areas

Wood Technology Activities. Investigate newer processes in wood technology such as plastic impregnation, wood flow molding, or test wood bending strengths, burn rates, nail holding strengths, and wood preservation characteristics.

Power Technology Activities. Test selected brands of oils for viscous stability under high temperature conditions, build testing devices to evaluate the lubricating properties of oil, or design apparatus to check the mileage obtained from selected brands of gasoline.

Plastics Technology Activities. Design and construct molds for such processes as injection, blow, compression, static, rotational, vacuum, and dip molding. Test the mold and demonstrate its use to a group of students.

Building Construction Technology Activities. Investigate newer construction processes or materials by gathering data, visiting with construction personnel, taking on-site field trips, and making a scale model using the particular process or material.

Metals Technology Activities. Conduct tests of various materials, fasteners, or welds. Use commercial or simulated testing apparatus. Write up the procedures used and the results obtained, then give a demonstration or presentation to a metals class.

Graphic Arts Technology. Conduct experimental activities with photographic chemicals, test inks for durability on various paper stocks, bending strength of various cover stock, or conduct advanced processes not performed in the regular graphics arts class.

Design-Drafting Technology. Investigate a field of design or drafting not covered in the courses you have taken. Write a report on particular procedures and special standards pertaining to the field. Apply your findings in a selection of drawings or illustrations.

Electricity-Electronics Technology. Investigate an aspect of electricity-electronics which you are particularly interested in. Write a technical report of your findings and construct a demonstration circuit or device to exhibit the knowledge or skills you have learned.

CHAPTER VI

ALTERNATIVE METHODS AND APPROACHES OF INSTRUCTION

Success in the classroom depends on many factors. Foremost among these is hard work on the part of the teacher. Educational programs must be adaptable. They must be flexible enough to remain workable in all locales, in many types of facilities, and with students possessing differing values and interests. A successful program must be capable of application in all situations and at all levels. The program recommended in the guide is believed to be such a program.

Curriculum content is not the only important element in the teaching-learning environment. Because of the differences in pupil learning styles and teacher proficiences, varied instructional methods must continually be evaluated and implemented. Traditionally, many instructional methods have been used in industrial arts and technology laboratories. Methods such as lecturing, demonstrating, designing, problem solving, and constructing individual projects have been recognized as effective instructional approaches for presenting content. Emerging instructional methodologies provide increased potential for presenting technical, industrial and career concepts. Some instructional patterns being used in innovative industrial arts programs today include:

Role Playing

The role playing method affords students the opportunity to identify themselves with typical life activities as they exist in simulated industrial occupations or professions. Through role playing, students can experience some of the reality of work responsibilities. It is especially well-suited for use with enterprise laboratory activities, mass production activities, research and experimentation, and group project experiences.

The Group Project

The group project method involves the designing, planning, and development of a product by a group of students. It differs from the mass production method in that only one finished product results from the activity of the group. Ideally, the project selected has numerous elements that permit the effective use of committees or other sub-groups. The method has been used successfully at the junior high level for studying high volume production industries such as paper and paper products, oil, iron, glass, and rubber. At the senior high level, the group project might take the form of designing and constructing a machine or vehicle prototype.

Conceptual Learning

Current educational theory emphasizes the need to develop fundamental principles and ideas which have functional value in a wide variety of applications. This learning generally is referred to as conceptual learning. For examples, the concept of molding enables the student to relate general knowledge and skills to many specific types of industrial processes in forging, foundry, and casting. A study of general or fundamental principles insures that memory loss will not mean total loss, and will permit reconstruction of details, when necessary. Concepts have greater application to new situations than specific facts.

Enterprise

The industrial enterprise approach represents a simulated production experience where students assume career roles and solve problems in a manner similar to their counterparts in industry. The enterprise method often involves such activities as research and development, financing, mass production, distribution and marketing. At Elementary and Junior High Levels, the emphasis might be directed toward production of items of a simplified nature. Limited time would be alloted for performance of the production activity. At the Senior High Level, production solutions are more refined and greater emphasis is placed on tooling for production.

Cooperative Work and Study

Many students enrolled in industrial arts programs can profit from on-the-job experiences which are designed to supplement in-school learning experiences. Such experiences assist students in further development of skills and positive attitudes toward work and school, aid them in assessing career goals, and enhance their potential for successful employment in the future. Other significant techniques include industrial observation schemes and community projects. All out-of-school industrial experiences

require supervision and evaluation by qualified school personnel to ensure that the experience and environment are adequately serving the student's educational goals.

Seminar

The seminar method emphasizes student interaction and contribution. It is used to identify individual problems and to provide for group assistance on finding solutions to these problems. The seminar provides a continuing opportunity for student peer evaluations as well as presentation of individual student progress. With the seminar method, the teacher assumes the role of a facilitator, observer, evaluator, and advisor. In the seminar, students become involved in challenging, questioning, assisting, and discussing. The method has been used successfully with the enterprise, group, research and experimentation and other more traditional instructional methodologies.

Individualized Instruction

Individualized instruction provides for the varying abilities and interest of students. It involves development of instructional units in a manner which enables the student to independently: (1) pre-assess his performance and knowledge of the unit objectives, (2) progress through specified learning activities at his own rate, and (3) assess his terminal performance and achievement of unit objectives. A variety of hardware and software systems have been developed to facilitate management of the instructional approach. These include auto-tutorial systems, tape-slide, tape-filmstrip, programmed references, student contracts, learning activity packages, educational games, and computer assisted instruction.

Using Community Resources

Methods must be selected that capitalize on the unique needs of students in specific locales. The teacher of industrial arts must be alert to the resources of his community and the opportunities for integrating these resources with the instructional program. Resource speakers, industrial visitations, films, slides, tapes, learning packages, and bibliographical resource materials must all be evaluated on the basis of their merit to the instructional program.

REFERENCES AND RESOURCES

LEVEL: Elementary

SYSTEMS EMPHASIS: Production, Communication, Energy

Books:

American Council on Industrial Arts Teacher Education. *Industrial Arts for the Elementary School.* 23rd Yearbook. McKnight and McKnight Publishing Co.; Bloomington, Illinois, 1974.

Calder, Clarence R., and Eleanor M. Antan. *Techniques and Activities to Stimulate Verbal Learning.* The Macmillan Co.; New York, N.Y., 1970.

Gerbracht, Carl, and Robert Babcock. *Elementary School Industrial Arts.* Bruce Publishing Co.; New York, N.Y., 1968.

Gilbert, Harold G. *Children Study American Industry.* Wm. C. Brown Co.; Dubuque, Iowa, 1966.

Miller, W.R., and Gardner Boyd. *Teaching Elementary Industrial Arts.* Goodheart-Willcox Publishing Co., Inc.; South Holland, Illinois, 1970.

Scobey, Mary-Margaret. *Teaching Children About Technology.* McKnight and McKnight Publishing Co.; Bloomington, Illinois, 1968.

Stunard, Arthur E. (ed.), *Books.* American Council for Elementary School Industrial Arts, A.I.A.A.; Washington, D.C., 1971.

Swierkos, Marion L., and Catherine Morse, *Industrial Arts for the Elementary Classroom.* Charles A. Bennett Publishing Co.; Peoria, Ill., 1973.

At least three industrial arts projects should be investigated:

1. Technology for Children (T4C) New Jersey
2. Technological Exploration, Ohio
3. Project ABLE (Northern Illinois University, DeKalb, and Peoria Schools)

LEVEL: Junior and Senior High

SYSTEMS EMPHASIS: Production

Books:

Arnold, Lionel K. *Introduction to Plastics.* The Iowa State University Press; Ames, Iowa, 1968.

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Burke, Arthur E., Dalzell, and Townsend. *Architectural and Building Trades Dictionary.* American Technical Society; Chicago, Illinois, 1971.

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Crispin, F.S., *Dictionary of Technical Terms,* Bruce Publishing Co., New York, N.Y., 1970.

Edwards, Lauton, *Industrial Arts Plastics,* Charles A. Bennett Co., Inc., 809 W. Detweiller Drive, Peoria, Ill. 61614, 1964.

Feirer, John L., *Cabinetmaking and Millwork,* Charles A. Bennett Co., Inc., Peoria, Ill., 1967.

Feirer, John, *General Metals,* McGraw-Hill Publishing Co., Manchester, Mo., 1967.

Gerrish, Howard H., *Gerrish's Technical Dictionary,* Goodheart-Willcox Co., South Holland, Ill., 1968.

Groneman, Chris H., and Everett Glazener, *Technical Woodworking,* McGraw-Hill Book Co., New York, N.Y. 10036.

Hammond, James F., and others, *Woodworking Technology,* McKnight and McKnight Publishing Co., Bloomington, Ill., 1966.

Helper, Donald, and Paul Wallach, *Architecture Drafting and Design,* McGraw-Hill, Manchester, Mo., 1971.

Lux, Donald, and Willis Ray, *The World of Construction,* McKnight and McKnight Publishing Co., Bloomington, Ill., 1971.

Lux, Donald, and Willis Ray, *The World of Construction Lab Manual,* McKnight and McKnight Publishing Co., Bloomington, Ill., 1971.

Lux, Donald, and Willis Ray, *The World of Manufacturing,* McKnight and McKnight Publishing Co., Bloomington, Ill., 1971.

Lux, Donald, and Willis Ray, *The World of Manufacturing Lab Manual*, McKnight and McKnight Publishing Co., Bloomington, Ill., 1971.

Milby, Robert F., *Plastics Technology*, McGraw-Hill, Inc., New York, N.Y. 1973.

Mix, Floyd M., *House Wiring Simplified*, Goodheart-Willcox, South Holland, Ill., 1973.

Ramsey, Charles G., and Harold Sleeper, *Architectural Graphic Standards*, John Wiley and Sons, Inc., New York, N.Y., 1970.

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Smith, Ronald C., *Principles and Practices of Light Construction*, Prentice-Hall, Inc., Englewood Cliffs, N.J., 1963.

Soderberg, George A., *Finishing Technology*, McKnight and McKnight Publishing Co., Bloomington, Ill., 1969.

Sundberg, Elmer W., *Building Trades Blueprint Reading*, American Technical Society, 4th ed., Chicago, Ill., 1967.

Swanson, Robert S., *Plastic Technology*, McKnight and McKnight Publishing Co., Inc., Bloomington, Ill., 1965.

Sweet's Architectural Catalog File, Sweet's Construction Division, McGraw-Hill Information Systems Co., 330 West 42nd St., New York, N.Y. 10036.

Sweet's Light Construction Catalog File, Sweet's Construction Division, McGraw-Hill Information Systems Company, 330 West 42nd St., New York, N.Y. 10036.

Wagner, Willis H., *Modern Carpentry*, Goodheart-Willcox Co., South Holland, Ill., 1973.

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"Soil and Water Conservation Is Everybody's Business," International Harvester Co., Chicago, Ill.

"Plastics Education Guide," Plastics Education Foundation, 4 Lorna Lane, Loudonville, N.Y. 12211.

"The Story of the Plastics Industry," Plastics Education Foundation, 4 Lorna Lane, Loudonville, N.Y. 12211.

"Compression and Transfer Molding," Plastics Education Foundation, 4 Lorna Lane, Loudonville, N.Y. 12211.

"Finishing and Decorating," Plastics Education Foundation, 4 Lorna Lane, Loudonville, N.Y. 12211.

"Injection Molding," Plastics Education Foundation, 4 Lorna Lane, Loudonville, N.Y. 12211.

"Introduction to Extrusion," Plastics Education Foundation, 4 Lorna Lane, Loudonville, N.Y. 12211.

"Thermoset Molding," Plastics Education Foundation, 4 Lorna Lane, Loudonville, N.Y. 12211.

"An Experimental Resource Unit in Plastics for Industrial Arts," Publications Distribution Unit, New York Education Department, Albany, N.Y.

"Plastics for Industrial Arts," State Department of Education, 120 E. Tenth St., Topeka, Kans. 06612.

"Vermont Plastics Guide," Vermont Department of Education, Montpelier, Vt.

"Plastics Guide - Plastics School," (16 volumes), Brodhead-Garrett Co., Cleveland, Ohio, or Cope Plastics Illinois, Inc.

"Fundamentals of Gas Metal Arc Welding," Miller Electric Manufacturing Co., Box 1087, Appleton, Wis.

"Gas Metal Arc Welding," Miller Electric Manufacturing Co., Box 1087, Appleton, Wis.

"The World of Steel," United States Steel Corporation, 71 Broadway, New York, N.Y.

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"File Filosophy," Nicholson File Company, Providence, R.I.

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"Sawology," Nicholson File Company, Providence, R.I.

"Flame Cutting Facts," Smith Welding Equipment, c/o UKI Supply Co., Box 37717, Cincinnati, Ohio.

"Arc Welding Symbols," Prig Institute, Hobart Welding School, Trade Square East, Troy, Ohio.

"Copper the Cornerstone of Civilization," Copper Development Association, Inc., 405 Teningston Ave., New York, N.Y. 10017.

Audio-Visual Aids

Transparencies on brick and stone masonry available from: DCA Educational Products, Inc., 4865 Stenton Ave., Philadelphia, Pa. 19144.

Transparencies on building construction available from: DCA Educational Products, Inc., 4865 Stenton Ave., Philadelphia, Pa. 19144.

Programmed instruction entitled "Reading a Micrometer" available from the American Society of Tool and Manufacturing Engineers.

Programmed instruction entitled "Fundamentals of Plastics" available from Penton Education Division. Penton Publishing Co.; Cleveland, Ohio 44113.

Kit available: "Select-A-Box Kit" from Edison Technical Services, Inc.; 70 Riverside Drive, New York, N.Y. 10024.

Industrial films available on loan from: SPI Film Catalog. The Society of the Plastics Industry, Inc.; 250 Park Avenue, New York, N.Y. 10017.

Industrial career film entitled "How to Crack the Establishment" available from: Plastics Education Foundation; 4 Lorna Lane, Loudonville, N.Y. 12211.

The PCA slide set entitled "Mr. Quality Concrete," is available from the Portland Cement Association; Old Orchard Road, Skokie, Ill. 60067.

The film, "Plastics: Industrial Processes and Products," (24 minutes, sound/color, correlated with *Plastics Technology*, by Robert Swanson) is available for rental from the University of Wisconsin-Stout.

Consulting Services on Curriculum and Laboratory Design available from Gib Klein Company; 1901 Mentzer Road, RR 1, Marion, Iowa 52302

LEVEL: Junior and Senior High

SYSTEMS EMPHASIS: Communications

Books:

Arnold, Edmund C. *Ink on Paper.* Harper and Row Publishers, Inc.; New York, N.Y., 1972.

Baer, Charles J. *Electrical/Electronics Drawing,* 3rd edition. McGraw-Hill Book Co.; New York, N.Y., 1972.

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Thomas, T. A., *Technical Illustration*, 2nd edition, McGraw-Hill Book Co., New York, N.Y., 1968.

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An encyclopedia of Graphic Arts terms and a variety of corporate brochures are available from: F.N. Burt Company, 2345 Walden Ave., Buffalo, N.Y. 14240.

"A Businessman's Guide to Container Design," and "Product Personality" available from: J.L. Clark Container Co., 2300 6th St., Rockford, Ill. 61101.

"Electrostatic Printing" is available from: Colorcon, Inc., Moyer Boulevard, West Point, Pa. 19486.

"Communicating with Graphics" and other general brochures are available from: A.B. Dick Co., 5700 West Touhy Ave., Chicago, Ill. 60648.

"Ideas Handbook" is available from: General Binding Corp., Northbrook, Ill. 60062.

A variety of brochures on paper are available from: Hammermill Paper Co., 1542 East Lake Road, Erie, Pa. 16512.

"Guide to Buyers of Typography" is available from: International Typographic Composition Association, 2233 Wisconsin Ave. N.W., Washington, D.C. 20007.

"Transfer Type Information" is available from: Letra-set, Inc., 33 New Bridge Road, Bergenfield, N.J. 07621.

Brochures on many phases of graphic communications are available from: 3M Company, Printing Products Division, 3M Center, St. Paul, Minn. 55101.

Career information brochures are available from: Printing Industry Technical Institute, 1514 South Street, Nashville, Tenn. 37212.

"Fundamentals of Offset," available from: Educational Services Department, A.B. Dick Co., 5700 West Touhy Ave., Chicago, Ill. 60648.

"Techniques of Offset," available from: Educational Services Department, A.B. Dick Co., 5700 Touhy Ave., Chicago, Ill. 60648.

"What It Means to Be a Rodman," is available from: The Iowa State Highway Commission, Ames, Ia.

"Can I Be a Draftsman?" is available from: Public Relations Staff, General Motors, Detroit, Mich.

"Designers Guide to Surface Texture," is available from: Micrometrical Manufacturing Company, 3621 South State Road, Ann Arbor, Mich. 48104.

"11 Ways to Save Drafting Time," is available from: The Frederick Post Co., 3650 North Avondale Ave., Chicago, Ill. 60618.

"Microfilming and You - the Draftsman," and "Preparation of Engineering Drawings on Drafting Film," are available from: Western Electric Co., Inc., Engineering Division, 222 Broadway, New York, N.Y. 10012.

"Reproduction Guide," is available from: International Association of Blue Print and Allied Industries, 33 East Congress Parkway, Chicago, Ill. 60605.

Audio-Visual Aids:

A number of slide series of varied aspects of graphic communications are available from: Eastman Kodak Company, Audio Visual Library, 343 State St., Rochester, N.Y. 14650.

A 60-page catalog on "Audio-Visual Aids Relating to Graphic Arts" is available from: Michigan Industrial Ed. Society, 14890 Penrod Ave., Detroit, Mich. 48223.

Graphic arts and printing training aids are available from: Miehle, Goss, Dexter, 2011 West Hastings St., Chicago, Ill. 60608.

The film entitled "It's a Screen Printed World" is available from: Advance Process Supply Co., 400 N. Noble St., Chicago, Ill. 60622.

The film entitled "Photography: Anatomy of Camera and Film: is available from: Charles Cahill and Associates, P.O. Box 3220, Hollywood, Calif. 90028.

The film entitled "We Used to Call It Printing" is available from the E.I. DuPont De Nemours Co., Photo Products Division, Wilmington, Del. 19898.

A film entitled "The Legend of the Halftone Dot" is available from 3M Company, Photo Products Division, 3M Center, St. Paul, Minn. 55101.

The following films are available from the Iowa State University Media Resource Center, Ames, Iowa:

"According to Plan-Introduction to Engineering Drawing"
"The Concepts and Principles of Functional Drafting"
"Discovering Line"
"Discovering Perspective"
"Discovering Color"
"Discovering Texture"
"Why Man Creates"
"Design and Man"
"Future Shock"

The film entitled "Basic Reproduction Processes in the Graphic Arts" is available from: University of Wisconsin, University Extension Division, Bureau of Audio-Visual Instruction, 1312 West Johnson St., Madison, Wis.

The film "Principal Dimensions, Reference Surfaces, and Tolerances" is available from: Visual Aids Service, University of Illinois, Division of University Extension, 1312 West Johnson St., Madison. Wis.

Film lists and catalogs are available from:

American Paper Institute, 260 Madison Ave., New York, N.Y. 10016

Eastman Kodak Co., AV Service Dept., 343 State St., Rochester, N.Y. 14650.

National Association of Photo Lithographers, 230 West 41st St., New York, N.Y. 10036.

Graphic Arts Technical Foundation, 4615 Forbes Ave., Pittsburg, Pa. 15213

Encyclopedia Britannica Educational Corp., 425 N. Michigan Ave., Chicago, Ill. 60611.

Valiant I.M.C., 237 Washington Ave., Hackensack, N.J. 07602.

McGraw-Hill Book Co., Text-Film Division, 330 West 42nd St., New York, N.Y. 10036.

EDU-PAC of Minnesota, P.O. Box 27101, Minneapolis, Minn., makes available the following learning activity packages:

G1 - Introduction to the four Major Printing Processes
G2 - Identification of Machines, tools and equipment commonly found in the graphic arts laboratory
G3 - Common Terms and Definitions used in graphic arts

G4 - Safety in the graphic arts laboratory
G5 - Occupational opportunities in the graphic arts field

Transparencies on graphic arts are available from: Demco Educational Corp., Box 1488, Madison, Wis. 53701.

LEVEL: Junior and Senior High

SYSTEMS EMPHASIS: Energy

Books:

Arnold, Joseph, and Kenneth Schank, *Exploratory Electricity*, McKnight and McKnight Publishing Co., Bloomington, Ill., 1960.

Beeler, Samuel, *Understanding Your Car*, McKnight and McKnight Publishing Co., Bloomington, Ill.

Billiet, *Automotive Engines - Maintenance and Repair*, American Technical Society, Chicago, Ill.

Crouse, William H., *Automotive Mechanics*, McGraw-Hill Book Co., Manchester Road, Manchester, Mo. 63011.

Duffy, Joseph, *Power - Prime Mover of Technology*, McKnight and McKnight Publishing Co., Bloomington, Ill., 1972.

Gerrish, Howard H., *Electricity and Electronics*, Goodheart-Willcox, South Holland, Ill.

Glenn, Harold T., *Automechanics*, Charles A. Bennett Co., Inc., Peoria, Ill.

Glenn, Harold, *Exploring Power Mechanics*, Charles A. Bennett Co., Peoria, Ill., 1973.

Lush, Clifford K., and Glenn Engle, *Industrial Arts Electricity with Workbook*, Charles A. Bennett Co., Peoria, Ill., 1971.

Matson, Carl E., *30 Instructional Units in Basic Electricity*, McKnight and McKnight Publishing Co., Bloomington, Ill., 1961.

Purvis, Jud, *All About Small Gas Engines*, Goodheart-Willcox, South Holland, Ill.

Stockel, Martin W., *Auto Mechanics Fundamentals*, Goodheart-Willcox Publishing Co., South Holland, Ill.

Stockel, Martin W., *Auto Service and Repair*, Goodheart-Willcox Publishing Co., South Holland, Ill.

Warthington, Robert, Margules, Morton, and Crouse, *General Power Mechanics*, McGraw-Hill Book Co., Manchester Road, Manchester, Mo. 63011, 1968.

Wetzel, Guy F., *Automotive Diagnosis and Tune-Up*, McKnight and McKnight Publishing Co., Bloomington, Ill.

Booklets:

"Automotive Instructional Material," Automotive Service Industry Association, 168 North Michigan Ave., Chicago, Ill. 60601.

"A Message to America's Educators About Plymouth Trouble Shooting," Plymouth Division, Chrysler Motor Corporation, Detroit, Mich.

"Compressed Air Power in Manufacturing," The Sub-Committee on Engineering Education of Compressed Air and Gas Institute, 53 Public Square, Cleveland, Ohio 44113.

"Facts About Spark Plugs and Engines," Champion Spark Plug Co., Toledo, Ohio.

"Automotive Emission Control and Tune-Up Procedures," Prentice-Hall, Inc., Englewood Cliffs, N.J.

"Facts for Study," Educational Services, Automobile Manufacturers Association, Inc., 320 New Center Bldg., Detroit, Mich. 48202.

"The Story of Gasoline," American Petroleum Institute, 6603 Euclid Ave., Cleveland, Ohio 44103.

"Car Buying Made Easier," Ford Motor Company Listens, P.O. Box 1972, The American Road, Dearborn, Mich. 48121.

"Standards for Automotive Service Instruction in Secondary Schools," Automobile Manufacturers Association, Inc., 320 New Center Building, Detroit, Mich. 42807.

"Delco-Remy Training Aids," Technical Literature Department, Delco-Remy, Division of General Motors Corp., Anderson, Ind. 46011.

"Service Training Aids," Ford Service Publications, P.O. Box 7750, Detroit, Mich. 42807.

"Basic Electricity," "Basic Electronics-vol. 1," "Basic Electronics-vol. 2, 1971, U.S. Government Printing Office, Washington, D.C.

"Learlum Turbine System," Lear Motor Corp., P.O. Box 10600, Reno, Nev. 89510.

Audio-Visual Aids:

Various filmstrips and transparencies available from: Filmstrips, Teaching Aids, Inc., P.O. Box 3527, Long Beach, Calif. 90803.

Basic experimenter system prepared by Ralph C. Bohn (consists of a textbook entitled *Power-Mechanics of Energy Control*, lab manuals on mechanical control, fluid control, electrical control, power systems, optional experiments, power problems, and workbooks and achievement tests). Available from McKnight Publishing Co., Bloomington, Ill. 61701.

Transparency Master Manual Set #690166 available from: Tecumseh Products Co., Parts Department Division, Grafton, Wis.

Transparencies also available from:

Charles Beseler Company, 219 South 18th St., East Orange, N.J. 07018.

United Transparencies, Inc., Box 888, Binghamton, N.Y. 13902.

3M Company, Visual Products, Box 3100, St. Paul, Minn. 55101.

DCA Educational Products, Inc., 4865 Stenton Ave., Philadelphia, Pa. 19144.

Gaskell Teaching Aids, 109 Farmdale Rd., Hopkins, Minn. 55343.

Assorted Filmstrips are available from:

Life Film Strips, Time and Life Building, Rockefeller Center, New York, N.Y. 10020.

McGraw-Hill Text Films, 330 West 42nd Street, New York, N.Y. 10036.

FOMC, Filmstrip-of-the-Month Club, Inc., 225 Lewington Ave., New York, N.Y. 10016.

Consulting Services on Curriculum and Laboratory Design available from:

Gib Klein Company, 1901 Mentzer Rd., RR 1, Marion, Iowa. 52301

RESEARCH AND DEVELOPMENT

Books:

Colburn, Robert, Chief Editor, *Modern Science and Technology*, D. Van Nostrand Co., Inc., Princeton, N.J.

Dictionary of Occupational Titles: A Plan for Filing Unbound Occupational Information, Chronicle Guidance Publications, Inc., Moravia, N.Y. 13118. (found in most school Guidance Departments)

Encyclopedia of Associations, Vol. I, National Organizations of the United States, Gale Research Co., Book Tower, Detroit, Mich. 48226.

The first 250 pages of this extensive volume list all registered organizations of the United States. The primary value is as a basic guide to
information on specific subjects. By contacting the professional societies listed you may be connected to a person highly qualified in any field or subject listed. An excellent source listing thousands of associations.

McGraw-Hill, *Encyclopedia of Science and Technology*, McGraw-Hill Publishing Co., Inc., New York, N.Y. (14 vol. + index)

The Way Things Work: An Illustrated Encyclopedia of Technology, Simon and Schuster, Rockefeller Center, 630 Fifth Ave., New York, N.Y. 10020. (Vol. 1 & 2)

U.S. Department of Labor, *Occupational Outlook Handbook*, Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

U.S. Department of Commerce, *U.S. Industrial Outlook, 1974: With Projections to 1980*, Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

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Industrial Education in Minnesota - A Guide for Elementary and Secondary Program Development, Minnesota State Department of Education, 1974.

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Mager, Robert F., *Developing an Attitude Toward Learning*, Fearon Publishers Inc., Palo Alto, California, 1968.

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Technology and Social Change, Wilbert E. Moore, ed., Quadrangle Books, Chicago, Illinois, 1972.

The Conceptual Base for Industrial Education Project, (3 cluster guides), The Kansas State Department of Education, 1974.

The Rockwell Power Tool Instructor, "Guidelines for Industrial Arts in Career Education," Pittsburgh, Pa., Volume 21, No. 1, 1974.

The Secondary Exploration of Technology Project, (cluster guides on power conversion and transmission systems, industrial communications systems and material analysis and processing systems), School of Technology, Kansas State College, Pittsburg, Kansas, 1974.

The Wisconsin Guide to Local Curriculum Improvement in Industrial Education, K-12, Wisconsin State Department of Public Instruction, 1974.

Weinberg, Alvin M., "Can Technology Replace Social Engineering," *Space Digest*, January, 1967.